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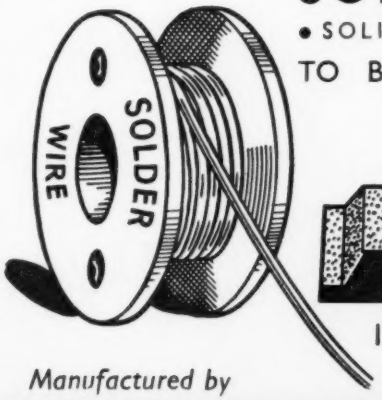

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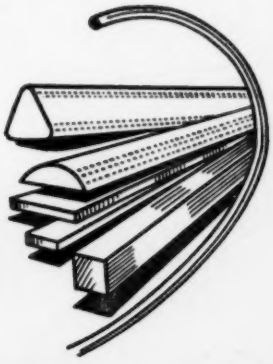

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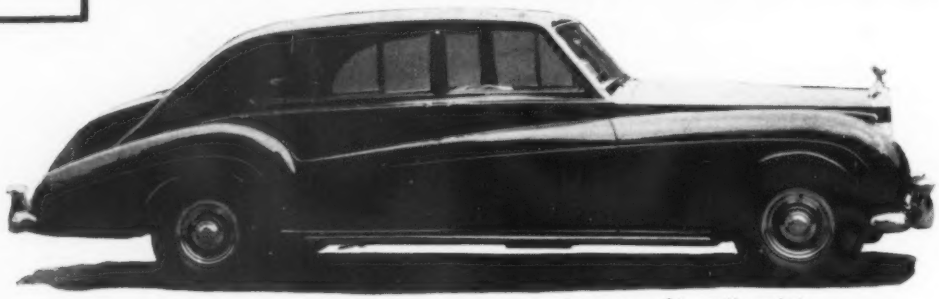

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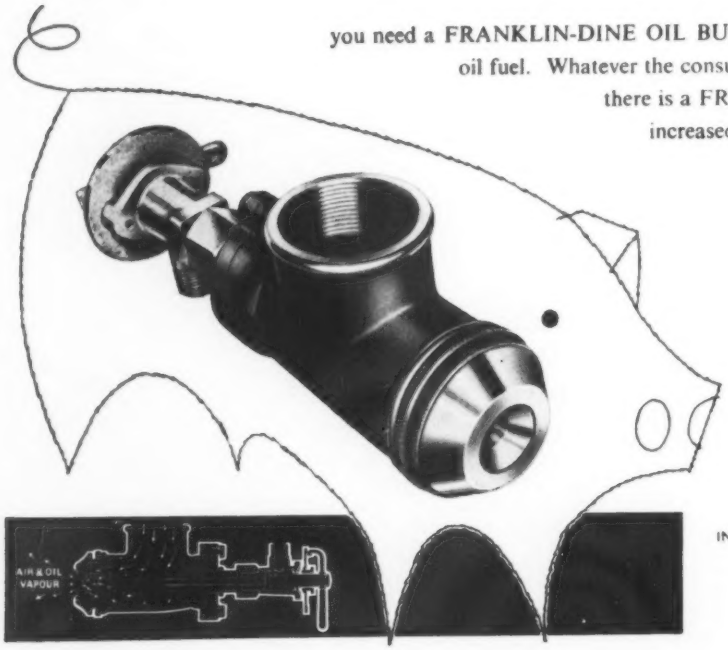

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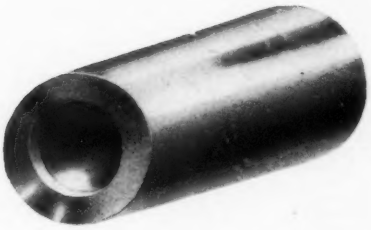

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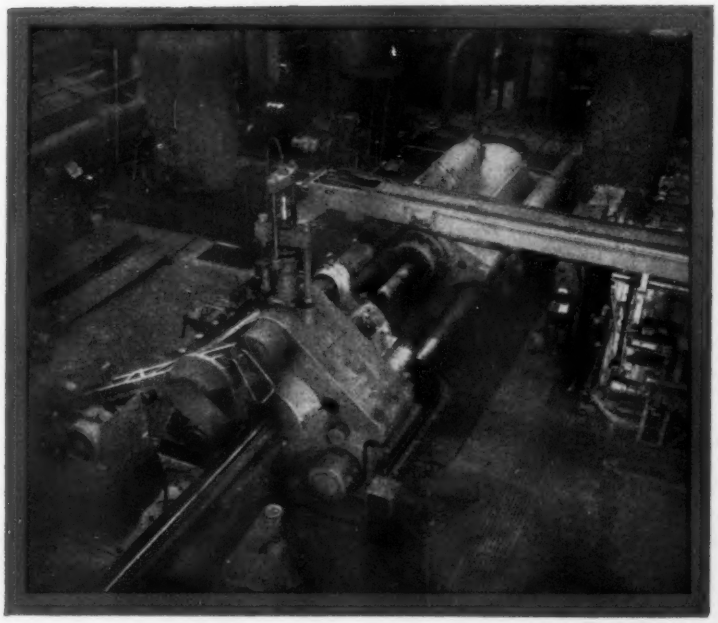

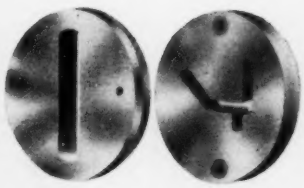

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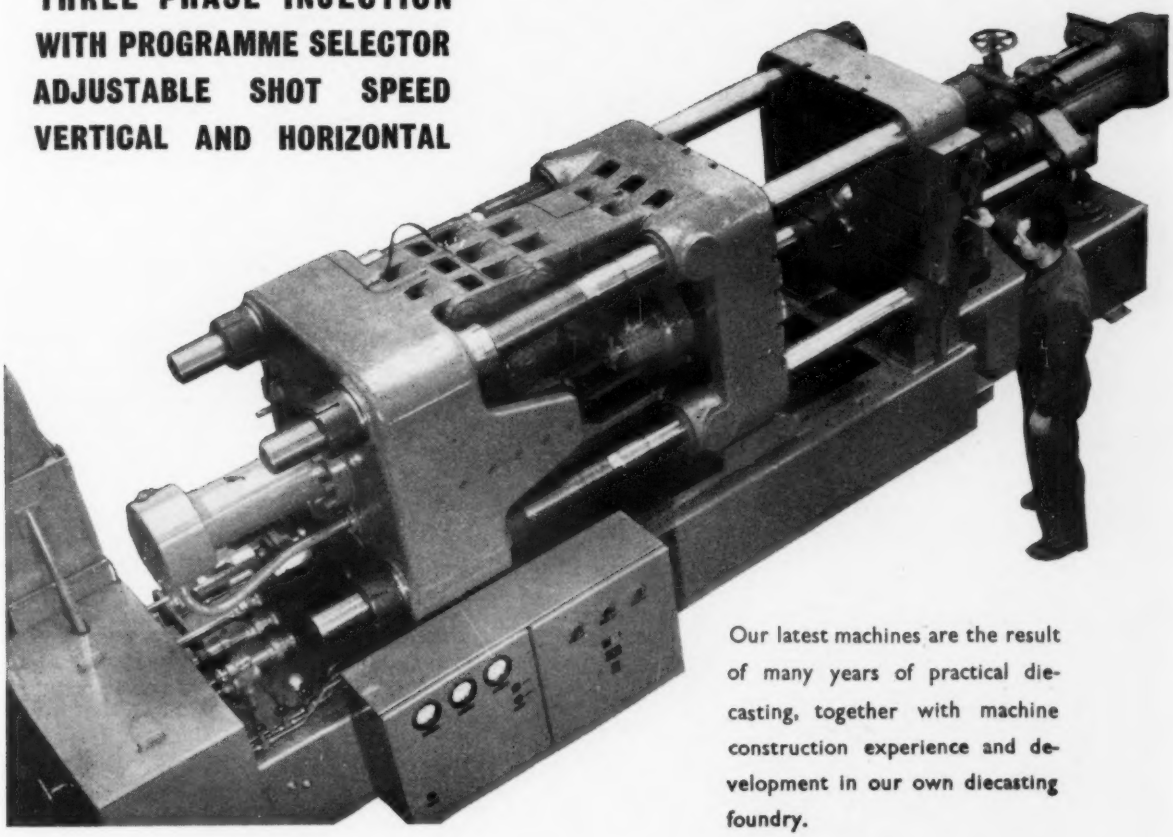

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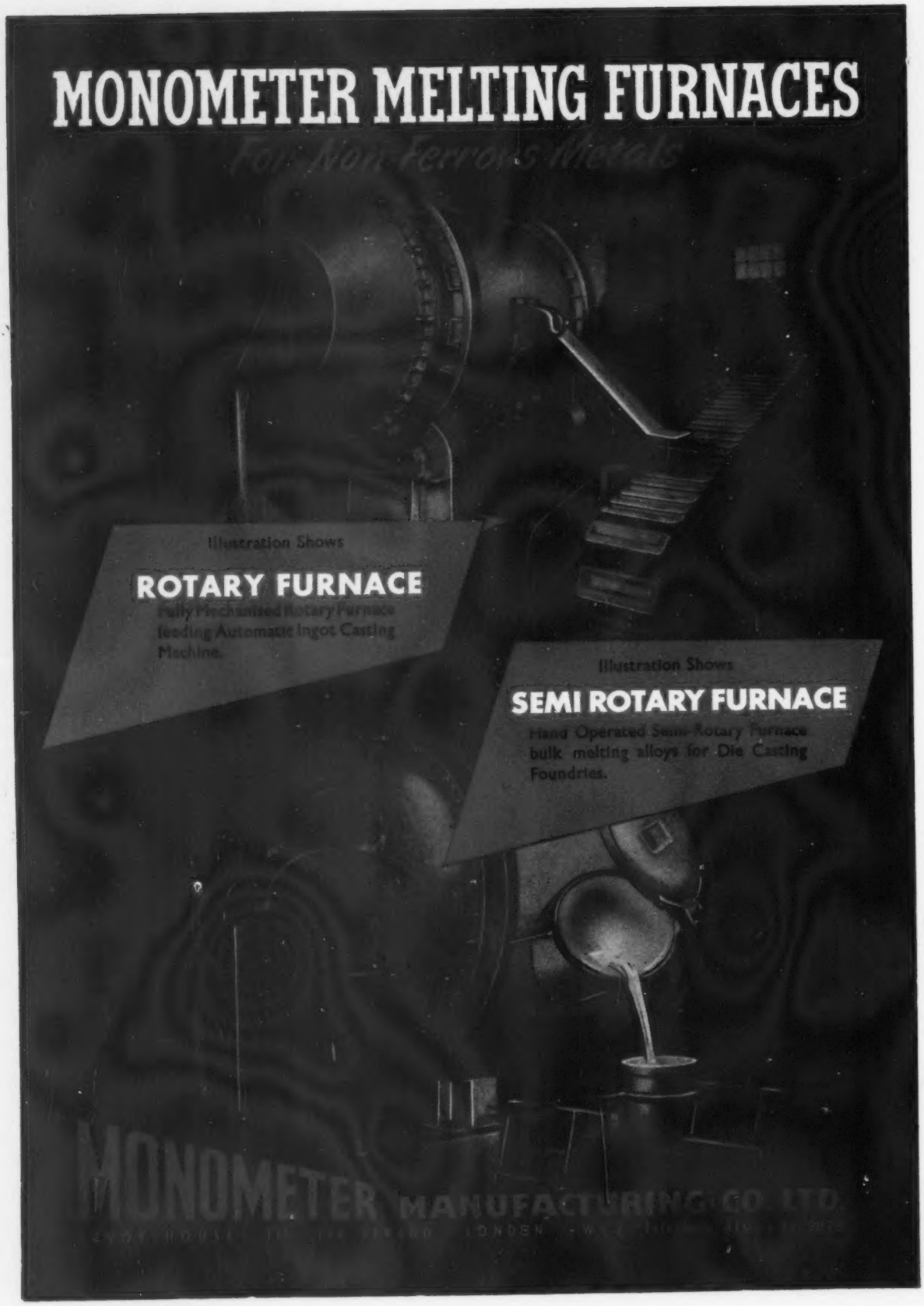
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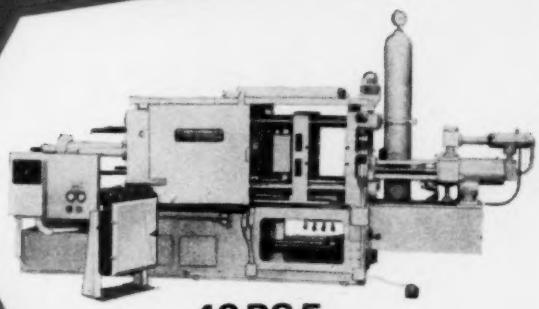
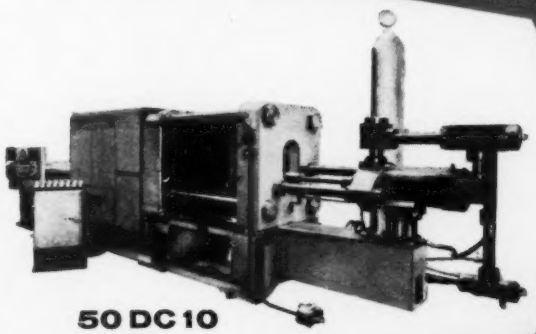


40 DC 5



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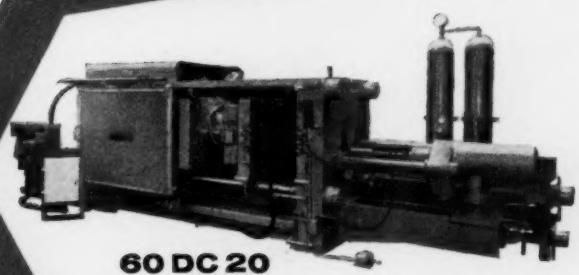

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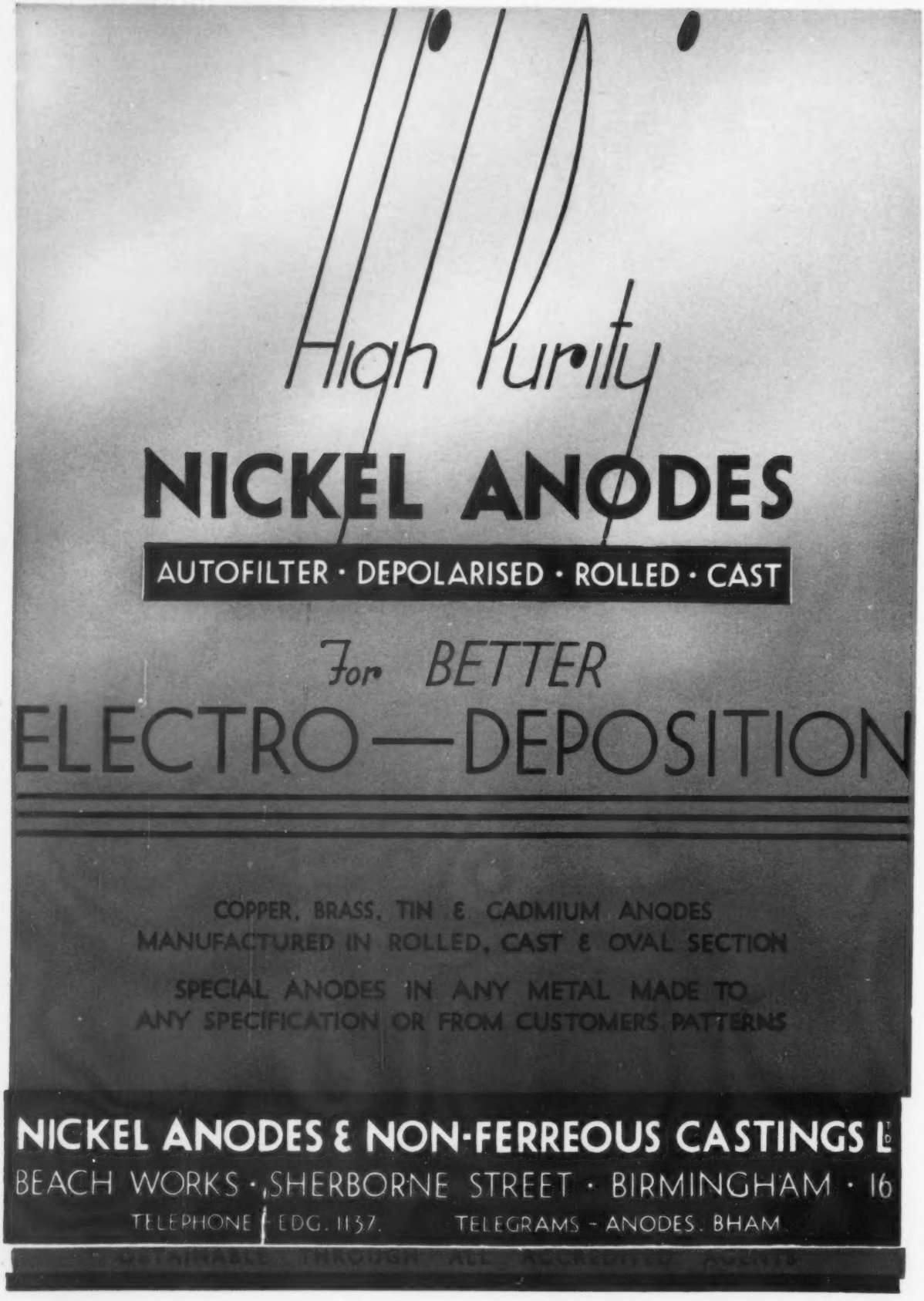
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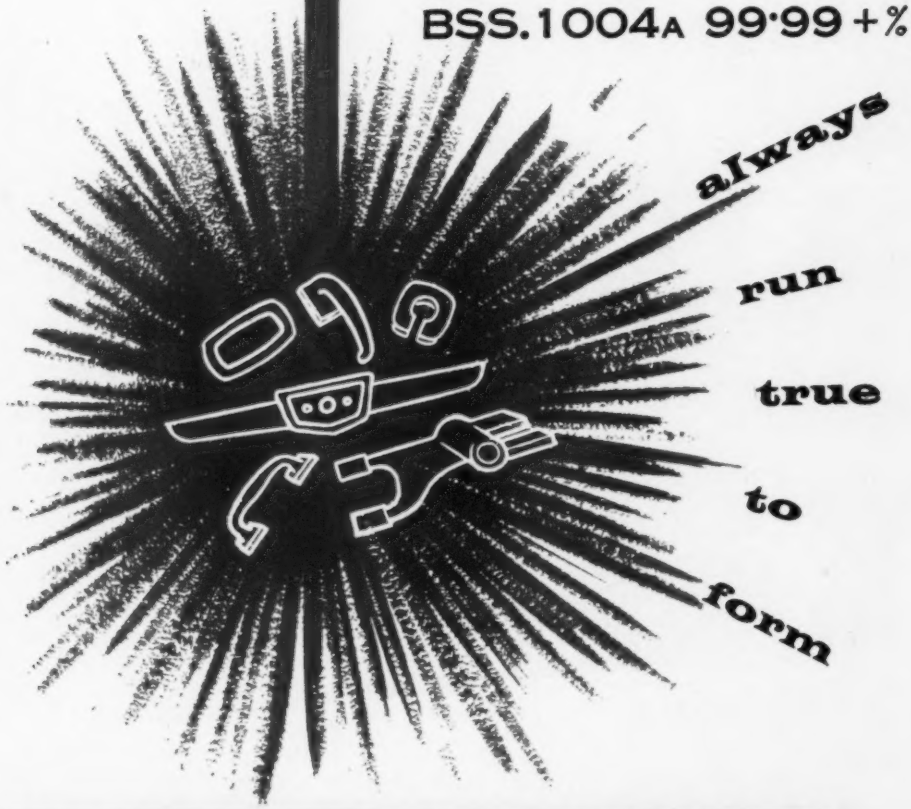

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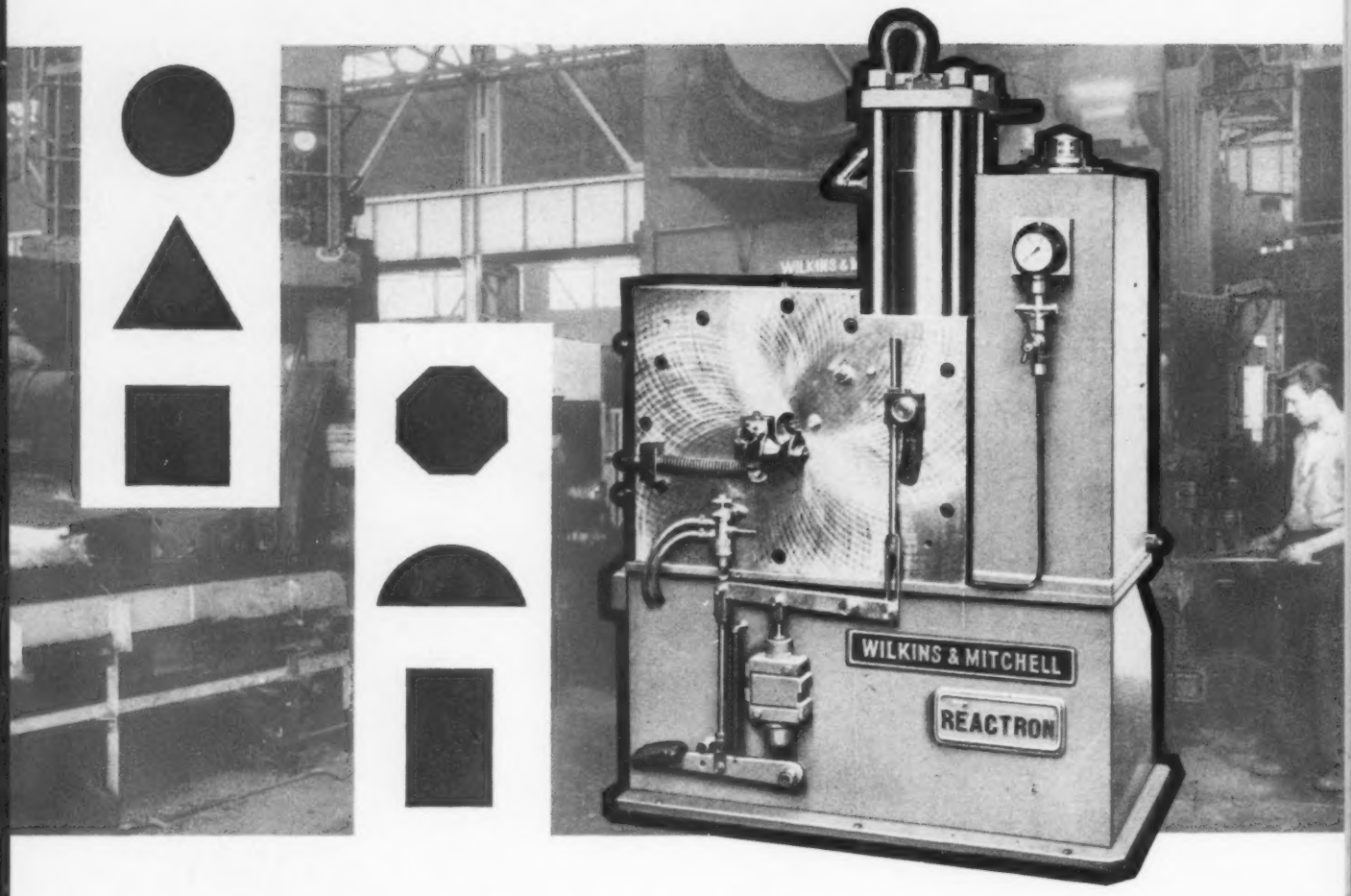

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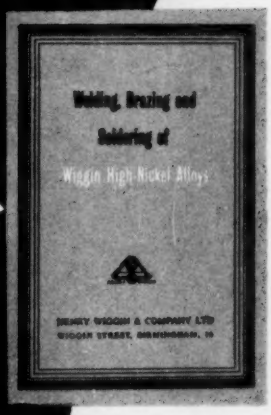

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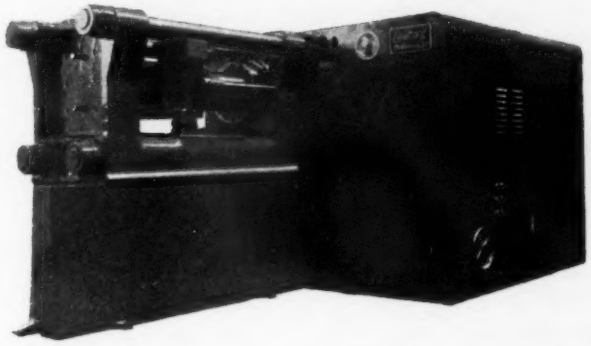

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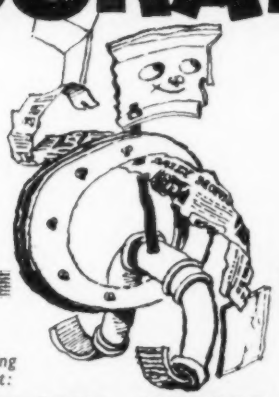

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24 MARCH 1961 VOLUME 98 NUMBER 12

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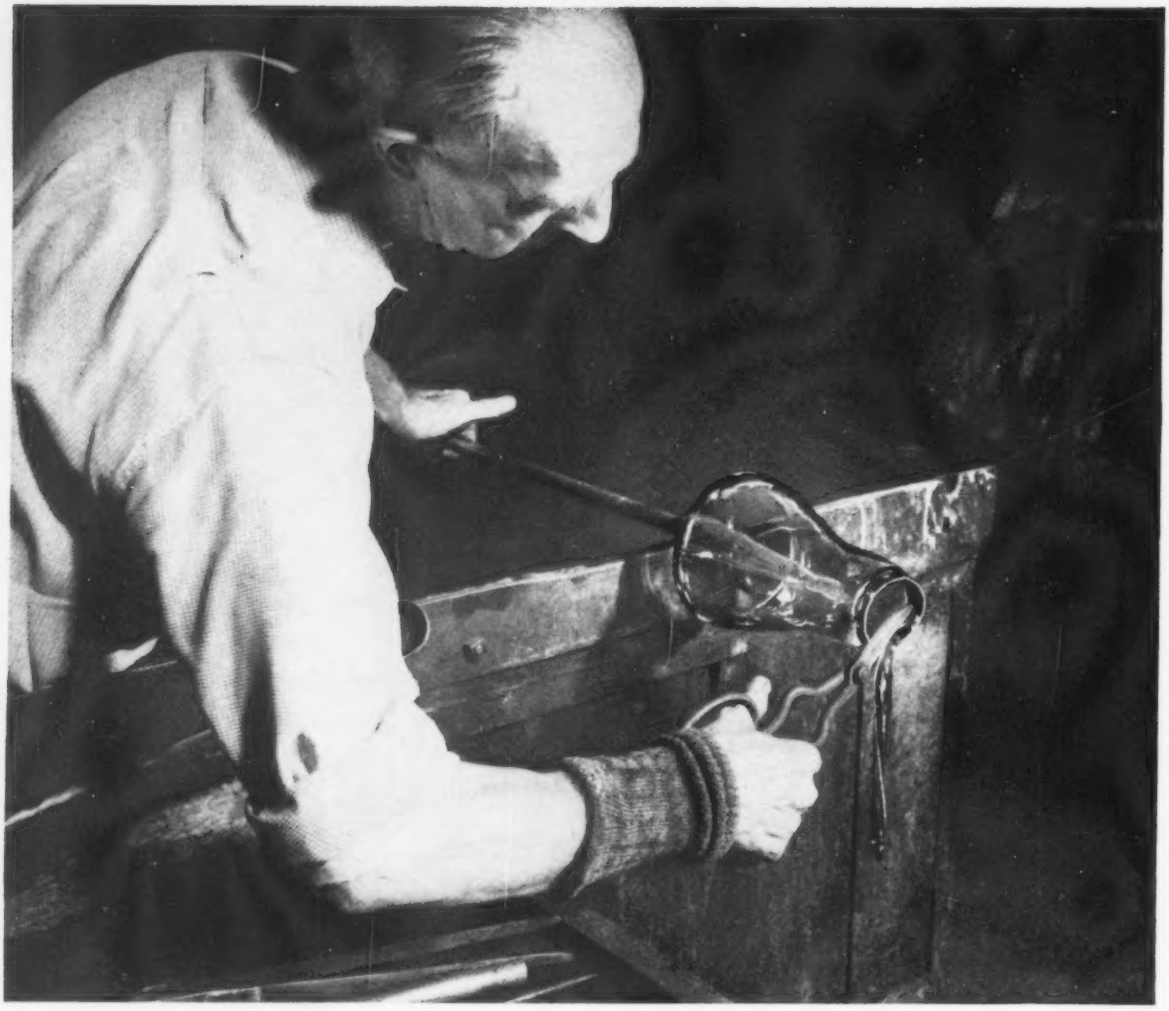

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PERFECTIONISTS notwithstanding, how fortunate it is that the average reader of scientific and technical literature is able to see only a relatively small proportion of what is published. How fortunate, too, that from all his studies, training, experience and past reading he will generally have managed to retain a very much smaller proportion of what has been described and what may, therefore, be regarded as known. Thanks to an effective though very much overworked defence mechanism, the average reader is therefore still far from the stage reached by those whose task it is to read and process published information, some of whom, appalled by its volume, have here and there started to suggest that progress could get bogged down by what is being made available. It has, for instance, been suggested that in the not-too-distant future even abstracts will have grown to a size beyond the ability of readers to scan.

To suggest such a possibility need not imply any doubt as to the ability of information scientists, using existing methods, to collect all available information on a given subject in the course of, say, two months' hard work, or the ability of some electronic marvel, as yet to be built, to retrieve the same information in the course of two minutes.

On the other hand, in the infrequent intervals between moans about the excessive volume of scientific and technical reading matter, the opportunity should be taken to consider and give thanks for all the scientific and technical reading matter one does not have to read; either because it is not available or because, for various reasons, it is never produced. By its very non-existence it is relatively inconspicuous. It is only on occasions on which enquirers not too well versed in the whys and wherefores of scientific and technical literature trustingly ask for it that its non-existence becomes apparent and has to be explained as best as may be.

Such explanations are rendered more difficult, and less convincing to enquirers than they might be, by the fact that the literature asked for is not, strictly speaking, non-existent. Literature on, for example, brightening additions to metal plating baths, the production of flux-coated welding electrodes, and fluxes for use in the melting and casting of aluminium and magnesium alloys can be found. To all an enquirer's intents and purposes, however, such accounts as can be found could just as well have been non-existent. Indeed, it would probably be far better if they were non-existent. A good deal of time at present wasted on producing, tracing and perusing such literature could thereby be saved. Not all the authors concerned are as candid as an eminent authority on aluminium foundry work, who concluded his discussion on the types and compositions of aluminium foundry fluxes by pointing out that the information given should not tempt the average foundryman to prepare his own fluxes and that he would do much better by obtaining his supplies from reliable manufacturers.

Out of the MELTING POT

Same Conclusion

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Besides the furnace design shown in Fig. 1, a larger unit (Fig. 2) was constructed with some improved features. The casting chamber, which enclosed the tilt-pour crucible, was of box-shape construction with outside reinforcement to prevent collapse under vacuum. The chamber was 6 ft. high, 5 ft. wide, and 6 ft. deep. The full-size door allowed use of a regular motorized fork lift to remove castings and exchange crucibles. The chamber was evacuated by two 5-h.p. 110 ft^3/min. mechanical pumps. The pressure in the furnace was normally in the range of 150μ during the operation.

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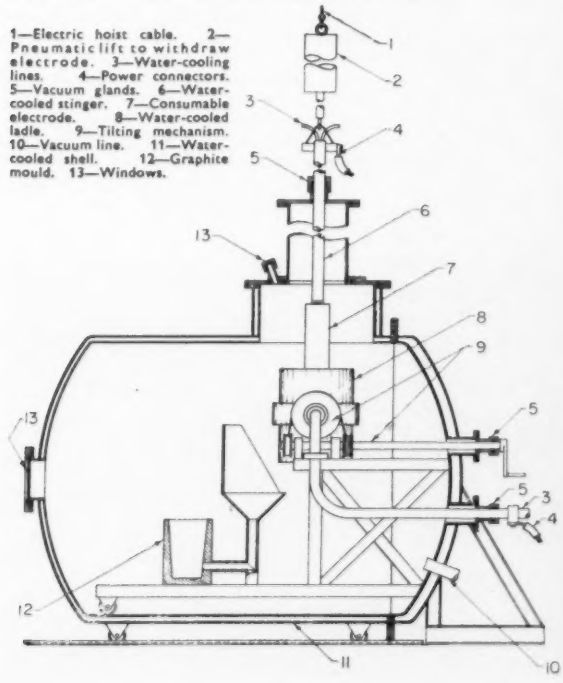

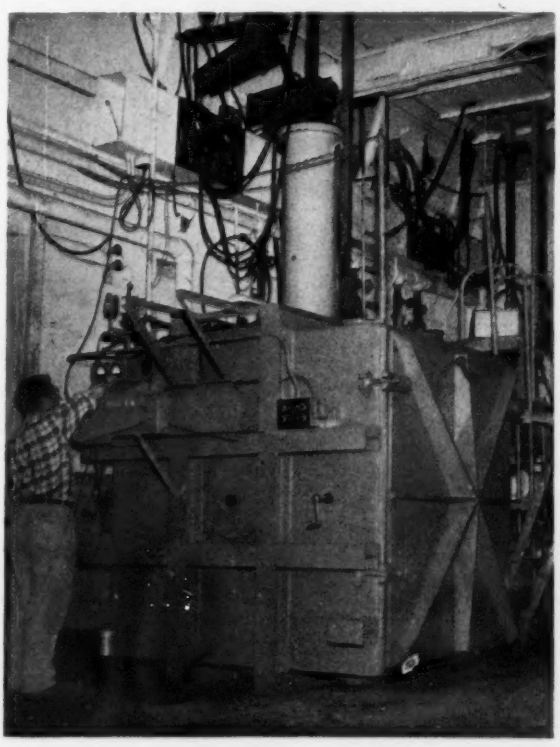

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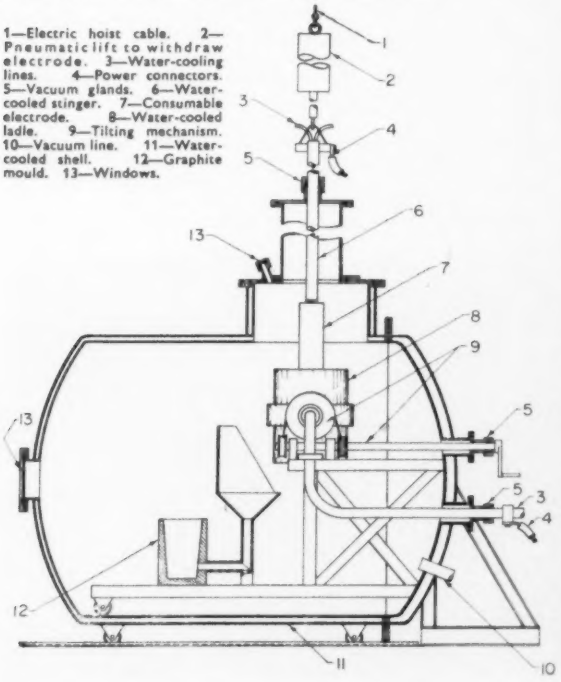
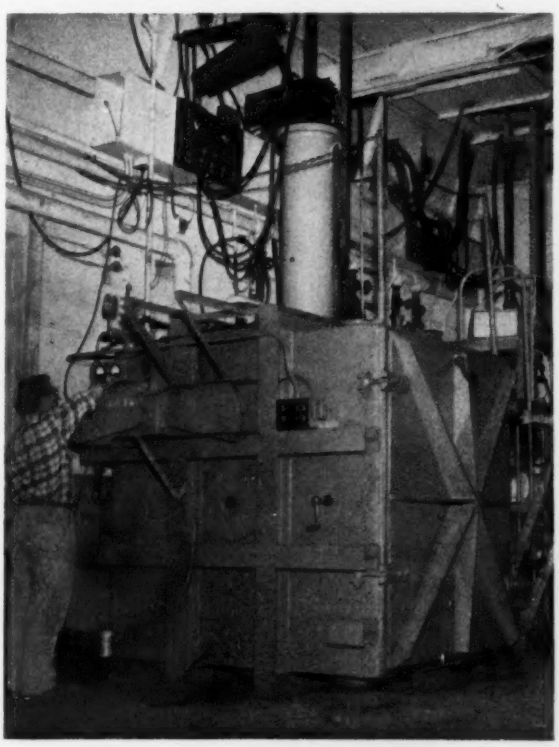




This furnace was originally fitted with a "sliding shoe" type of electrode assembly. The consumable electrode was connected to a massive copper block having three independently sprung graphite-faced shoes, which contacted the inside of a double wall water-cooled tube. This tube served as the power contact and housed the electrode. Electrode motion was effected by a winch and cable mounted inside a chamber at the top of the power contact tube.

The graphite facing of shoes was not included in the original design, but was added to avoid uneven current flow, development of hot spots, and accidental spot-welding of metallic shoe faces to the power contact tube. There was some apprehension that graphite abraded from the shoe facings would fall into the molten pool; however, this did not occur.

The one advantage of this electrode assembly was that larger consumable electrodes could be supported within a given overhead clearance. The chief disadvantage was awkwardness in mounting consumable electrodes. Because the copper shoe block was totally enclosed, it had to be removed from the power contact tube to affix the consumable electrode. Even then, the block was difficult to grip while making the threaded connection commonly used. This disadvantage probably could have been overcome by slight modifications in design, but a period of trial operation revealed that limitation of arc power restricted the maximum pour to a weight that could be accommodated in the available overhead space by a shaft or "stinger rod" type of electrode assembly. Accordingly, the more familiar and straightforward shaft suspension shown in Fig. 2 was adopted.

Crucibles up to 14 in. in diameter have been used in this equipment, and the maximum weight of cast metal was 195 lb. titanium or 280 lb. zirconium. The maximum current available in the laboratory slightly exceeds 12,000 amp., which is probably 2,000 amp. less than the ideal for the 14 in. crucible.

Remote operation is considered essential in arc casting because of the incidence of disastrous explosions in industrial titanium-melting furnaces. To protect the operating crew, the entire melting and pouring cycle was controlled from a remote location. Because of the non-routine nature of most operations, it was considered essential to provide visibility into the furnace. To achieve this, an optical system was installed to project images of the molten metal and the arc on a ground-glass screen in the control room.

The furnace schematic diagram in Fig. 1 shows that two view ports are mounted over the crucible. Angle-mounted first surface mirrors were installed over the view ports, aiming the image of the crucible horizontally toward the control booth. Immediately outside the booth are two 3-lens optical systems, which projected the two images through a 2 in. thick plastics window to a ground-glass screen inside the booth. The two images, each showing about one-half of the crucible, are projected side by side, giving effectively a full view of the crucible.

The lens tubes are mounted on a plate, which, in turn, slides on vee-ways on a steel frame. This feature allows the lens systems to be moved out of the way during furnace charging and unloading, yet permits exact repositioning of the lenses.

The chief advantages of this three-lens unit are possible wide variability in installation dimensions and small variation required to focus on a changing pool level. A further convenience is that the ground glass can be moved manually to focus rather than moving one of the lenses. Lens movement would require a complex remote-operated mechanism.

Alloying Methods

Normally, alloy additions are made to the sponge compact before first melting. Usually, an effort is made to confine the additions to the core of the briquette to eliminate alloying during welding of the compacts. Double-melted, or at least single-melted, sponge is used for the final casting electrode to minimize porosity in the product.

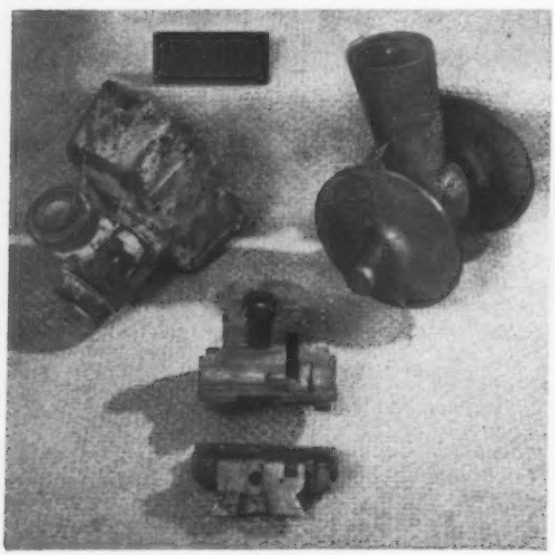
An interesting variation practised was the production of a cast alloy by the use of commercial bars of the several ingredients welded together to form the electrode. An alloy of uranium, niobium, and zirconium was produced with reasonable homogeneity by this technique. Similarly, binary alloys with less tendency to segregate have been cast successfully with a laminated electrode.

Mould Materials

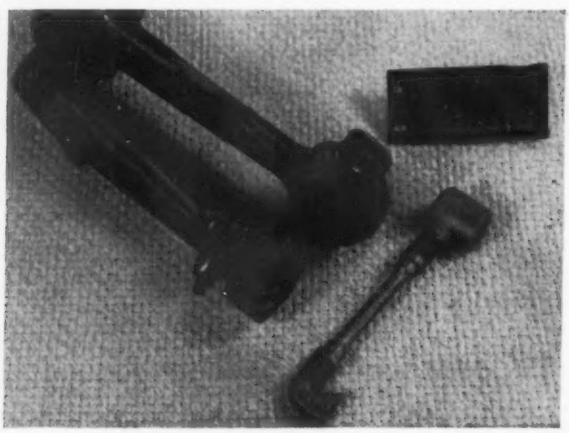
The problems of mould materials are inseparable from any discussion of casting techniques. With reactive metals, these problems are compounded many times. Common foundry sands are useless, and only materials that are relatively inert and insoluble in the melt can be considered.

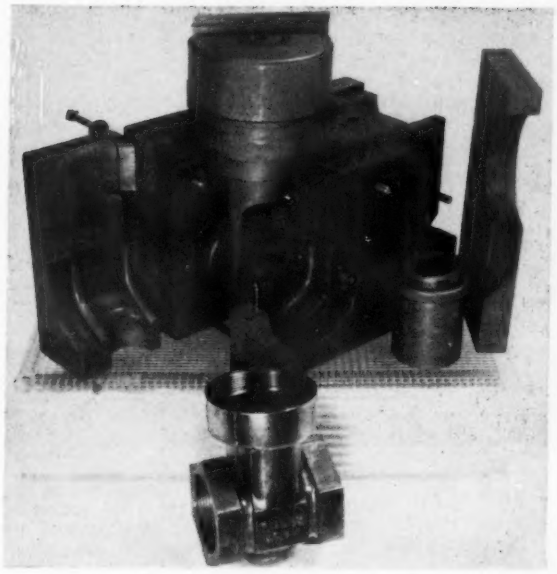
Basic requirements for mould material used in casting any metal are (1) the ability to resist attack by the molten metal, (2) a quality of surface finish that will produce a satisfactory casting, and (3) a structure that can be readily broken up when moulds are expendable or can have a relatively long life when moulds are permanent.

When the reactive-metal casting technique was first satisfactorily developed in 1955, three mould materials were available: namely, machined artificial graphite, rammed powdered graphite, and massive and/or water-cooled



Figs. 3 and 4—Titanium castings from zirconium silicote moulds produced by the frozen mercury investment technique





Left: Fig. 5—Laminated mould for titanium gate valve

Below: Fig. 6—Laminated mould for titanium diaphragm valve

Bottom: Fig. 7—Machined graphite mould with laminated core dismantled

copper or aluminium. This choice of materials has not yet been extended, although considerable refinement has been achieved, particularly in expendable rammed graphite.

Among the interesting alternative materials tested was zirconium silicate formed into moulds by the frozen-mercury investment technique. Figs. 3 and 4 indicate that mould reaction is severe except on the thin casting sections. Oxygen contamination on the thin sections was less than 0·03 to 0·04 in. deep.

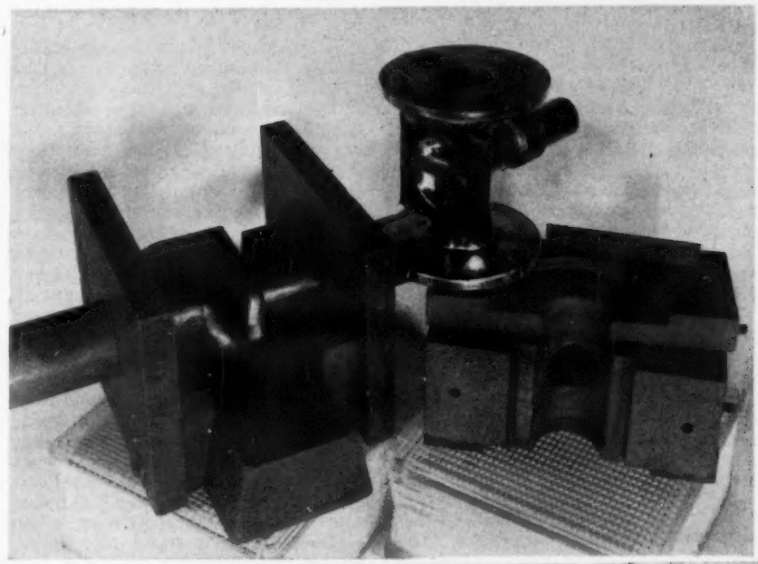
Choice of mould material for the production of any given casting must be governed by the end use of the casting and by the physical and mechanical specifications to be met. Castings poured into machined graphite moulds had an as-cast surface equal or superior to that of the best commercial die-casting, whereas castings produced in expendable or rammed graphitic moulds were rough and somewhat discoloured. Castings produced in machined graphite generally were lower in carbon contamination and more resistant to corrosion, but were more costly. Where a superior finish or corrosion resistance is not required, expendable graphite moulds provide a more economical method of producing titanium and zirconium castings. Massive and water-cooled metallic moulds are useful in producing castings with no surface contamination due to mould reaction, but they are ungainly to handle, costly to produce and generally limited to simple shapes.

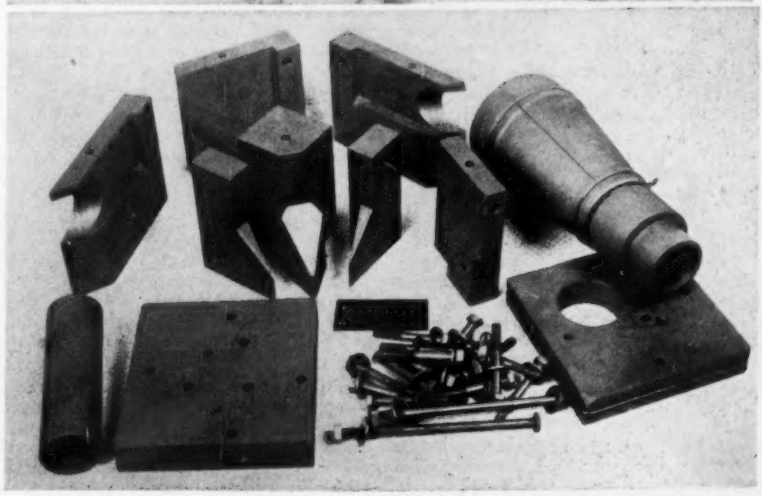
Machined Graphite

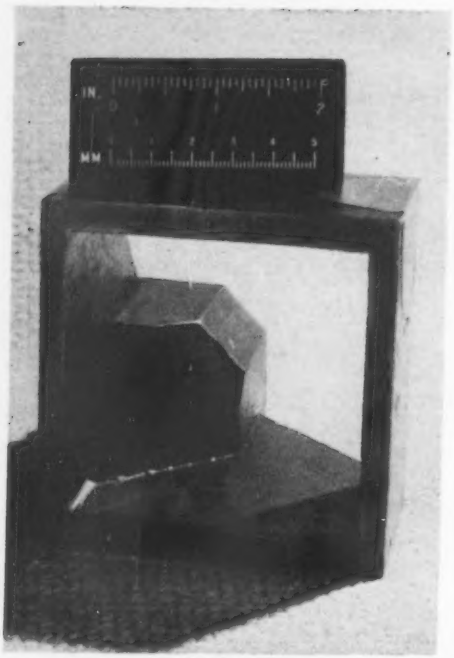
Dense graphite was an early choice as a mould material for zirconium and titanium casting. The ease with which this material is machined, its reasonable strength, high thermal conductivity, and low reactivity with the molten metal, make graphite suitable for a permanent mould material for many casting applications.[3]

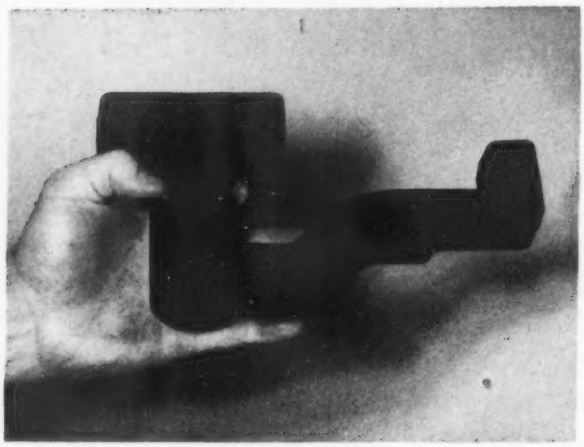
One of the greatest problems in designing machined graphite moulds is how to prevent the casting from binding the mould when it shrinks. For example, the conventional flanged valve will have two flat flanges parallel to one another and connected by a straight section. On cooling, the shrinkage of the straight section will cause the flanges to pinch tightly against the mould parts, making it difficult, if not impossible, to save the "permanent" mould for reuse. To solve this problem, a system of laminar construction with tapered key sections has been worked out. Figs. 5 and 6 show typical laminated moulds. The laminar construction reduced the breakage and simplified the machining of deep cavities. Cores also can be made of multisection units with a key block, as shown in Fig. 7. Fig. 8 shows the resultant casting.

It is necessary to obtain fine-grain dense graphite (1·65 gm/c.c. or more),









Left: Fig. 8—Cast zirconium reactor part from mould shown in Fig. 7

Above: Fig. 9—Blown core after firing

to realize the best surface finish on the casting. Care in preparing radii and in smoothing mould faces was essential to good castings and good mould life. No single part was produced in enough quantity to determine the average mould life of a properly designed unit. However, several patterns have been used 8 to 12 times with negligible deterioration.

Inspection of a casting poured in graphite makes it apparent that the molten metal was in contact with the graphite for only a fraction of a second before it froze and shrank away from the mould surface. In some instances, reaction and washing were observed where a heavy flow of metal impinged on a graphite surface.

Rammed Mould Material

Expendable, powdered graphite moulds have certain advantages over machined graphite moulds. In some instances, material with a lower heat conductivity than machined graphite promotes internal soundness. There is an obvious need for an inexpensive, suitably inert, expendable mould material that can be easily formed with standard foundry equipment. The Bureau recognized this need and made preliminary studies in 1954.[1]

The next step forward in the development of a material of this type was the announcement by Feild[4] in 1956 of a carbonaceous mix capable of being prepared and used in the average commercial foundry. Basically, this mix is composed of electric-furnace graphite powder AFS 80. Binders include common starch for green strength, pulverized pitch, and carbonaceous cement. The fluid vehicle is water plus a surface active agent. Although the mix and the techniques involved are still undergoing improvement, a basic operating procedure has been established. The best composition was reported to be " . . . 53 per cent electric-furnace graphite powder (−20, +100-mesh), 10 per cent dry corn starch, 10 per cent pulverized pitch, 8 per cent carbonaceous cement, 1 per cent surface-active agent (Dupanol G, a fatty alcohol amine sulphate) and 18 per cent water".[4] The foregoing mould material has been evaluated,[5] and at least one commercial producer of titanium castings is using this form of expendable mould.

A new programme for developing and evaluating expendable carbonaceous moulds was begun in 1957. Considering the approach used by Feild, and after evaluating the cited material on the basis of casting quality, the Bureau decided to attempt the production of a carbonaceous mould mix completely devoid of free water or water-containing materials.

Surface contamination of a casting, caused by its reaction with a given mould material, is partly dependent on the solidification rate. This, in turn, is a function of the thermal conductivity of the mould, a factor of which is the mould density. The condition of the mould faces is also a factor governing mould-metal reaction. A rough, soft surface tends to "wash", and any corners or prominent projections may be completely eroded.

The internal soundness of a casting is also affected by the thermal conductivity of the mould material. When a material such as machined graphite is used, surface laps or flowlines, internal shrink pockets, and, possibly, some gas entrapment, may result because of the lack of permeability and the comparatively high thermal conductivity of the mould material. In most instances, these can be controlled adequately by proper gating and risering, and are not serious deterrents to the use of machined graphite. However, thermal conductivity and permeability are factors that must be compromised to form castings, having little or no surface contamination, surface laps, or internal porosity.

The mould material developed by the Bureau, and the process for its production are still undergoing evaluation, and some alteration of formula and process is expected. At present, however, the blend is composed of powdered graphite, linseed oil, and wax combined with one or more of the following ingredients: corn starch, cereal binder, dextrine, powdered sugar, and powdered pitch.

The dry ingredients are blended in a double-cone-type blender. The linseed oil and wax, heated to "stand" temperature (to permit partial polymerization), are added to the blend, and the mass is thoroughly mixed in a ribbon mixer. The resultant blend may be hand-rammed, blown, or otherwise treated as in standard sand-moulding practices. Fig. 9 shows an expendable graphite core produced on a commercial core blower from the material being developed and evaluated.

After being rammed, the mould is stripped and then aged at room temperature. This ageing time, which varies from 12 to 72 hr., depending on mould or core dimensions, allows the oil and wax mixture to "stand" or partly polymerize, thus giving the green mould adequate strength for handling.

A low temperature drying cycle is necessary before firing. The assumption is that drying at 200°F. for 48 to 120 hr. facilitates the removal of volatiles. If this low-temperature drying cycle is omitted, the sudden evolution of volatiles during the high temperature firing (up to 960°C.) causes the mould or core to be distorted and to become porous or, in some instances, to disintegrate completely.

After treatment at 200°F., the material is adequately hard but still

contains enough volatile materials to cause excessive gas in the mould; therefore, more complete carbonization is necessary. This is accomplished by placing the mould in an electric furnace and heating it in a reducing atmosphere, elevating the temperature to a maximum of 960°C. This temperature is maintained for ½-1 hr. The mould is allowed to remain in the furnace during the cool-down period to prevent oxidation.

The reducing atmosphere in the electric furnace is provided by embedding the core or mould in commercial pulverized coke in a covered stainless steel container. In some instances, adequate protection is achieved by omitting the coke bed and merely sealing the steel box with a graphite cover. Bedding is useful for moulds or cores susceptible to distortion.

The decision to limit the time and temperature to the values shown is strictly abitrary. Earlier work showed benefits in using temperatures up to 2,000°C. and long time cycles. Vacuum firing would also be an improvement; however, temperatures above 1,000°C. and reduced pressures are not easily obtained in commercial equipment, and time is a factor that must be compromised with quality in practical application.

After curing and firing, the material had a hardness of Durometer 95 to 100 and a density of 0·95 to 1·28 gm/cm³, compared with that of commercial dense-grade graphite of 1·7 gm/cm³. The thermal conductivity was 20 B.Th.U/in/ft²/hr/°F. for the rammed material, which was approximately one-quarter that of commercial dense-grade graphite and up to twice the value listed by Frankford Arsenal[4] for their rammed mix.

Whenever practical for a given configuration, the technique of core-blowing has advantages over hand-ramming. Use of a core-blowing machine and blow-box moulds increases the production rate and efficiency, and, considering permeability and density, produces a superior core.

References

1 R. A. Beall, F. W. Wood, J. O. Borg and L. H. Gilbert; Bureau of Mines Rept. of Investigations 5265, 1956.

2 H. L. Gilbert, R. A. Beall and J. O. Borg; U.S. Patent 2825641.

3 F. W. Wood and R. P. Adams; *Light Metals Age*, 1957, **15**, 7-8, 18.

4 A. L. Feild, Jr.; *Metal Prog.*, 1956, **70**, 4, 92.

5 H. W. Antes, J. T. Norton and R. E. Edelman; *Modern Castings*, 1958, **33**, 4, 69.

(To be continued)

Strip Thickness Measurements

RECENTLY introduced to this country by Daystrom Ltd. is a non-contact gauge used primarily with rolled or extruded products which is suitable for a wide variety of materials in this field.

The gauge is known as the XactRAY and consists of three basic elements, an X-ray generator, which directs controlled beams of X-rays through the material being measured, the X-ray incident unit or pick-up, which converts the transmitted electromagnetic energy into an electrical signal, and an electronic console, which computes and converts the signal into meter indications. Dimensional changes are displayed as a deviation from the pre-set nominal thickness on an indicator calibrated in any unit of density or thickness.

A signal proportional to thickness deviation is available to operate automatic thickness control, data logging devices, and strip chart recorders for permanent records, or devices for the marking of off-gauge material.

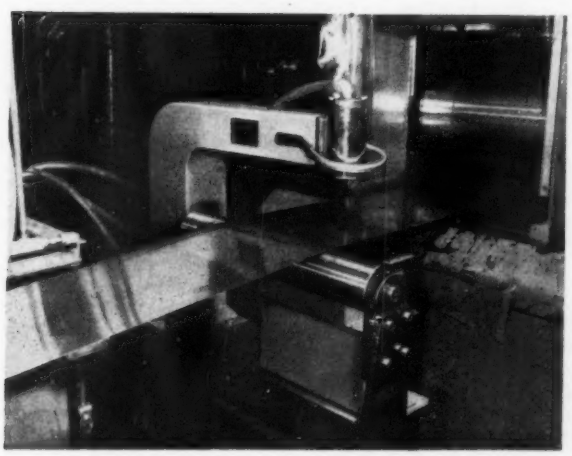
The X-ray generator and pick-up unit are mounted on opposite sides of the strip, usually on a steel "C" type frame, so that their distance apart is fixed; this distance varies, depending on the application, between 6 in. and 36 in. The frames can be mounted on wheels and motorized to allow positioning of the X-ray beam at any point across the width of the strip. Where space is limited, the X-ray generator and pick-up unit can be permanently mounted in the production machine. The XactRAY is of compact design, and a gauging carriage to measure up to 2 in. in aluminium is only 6 in. wide.

Both X-ray generator and pick-up unit have been designed to operate under severe mill conditions and are sealed against oil, water and steam. In situations where they are liable to mechanical damage, special armoured gauges are available.

A patented feature of the XactRAY is a device for inserting metal standards into the X-ray beam for calibration purposes. These standards are enclosed in a sealed chamber directly above the X-ray source and are inserted into the beam by rotary solenoids. The system enables an operator at a remote position to select the exact thickness to be measured in increments as small as 0·0001 in. Normally, the XactRAY can be set to a new thickness range in less than 10 sec., including time for recalibration. Where materials of different densities are to be gauged, a multi-position selection switch, which automatically compensates for any variation of density, is provided.

Five models of the gauge give a range from 0·00035 in. for aluminium foil to 2 in. steel plate; any one model has a thickness range of up to 200:1 (a 60 kV X-ray generator is suitable for 0·010-2·0 in. of aluminium). Accuracy is better than ±1 per cent of the thickness being measured and to special order this figure can be improved to 0·5 per cent. Stability is guaranteed for at least 8 hr.

The X-ray generator mounted below the material emits a thin pencil beam of X-rays. Only a tiny proportion of this beam emerges from the strip to energize the pick-up unit and is approximately the same for all X-ray sources and materials; this is due to the inherent flexibility of the generator—the X-ray intensity being adjusted to the material and thickness to be measured—i.e. a small output for thin or low density materials, unlike other radiation systems, is given.



Gauging carriage of the Daystrom X-ray device for measurement of strip thickness

Cleaning of Surfaces

IN our issue of 17 February, the ultrasonic units referred to on p. 130 and shown in Fig. 6, are distributed in the U.K. by Electro-Chemical Engineering Co. Ltd., not manufactured by them, as stated. The manufacturers are Technochemie A.G., Zurich.

Standard Specifications

Inspection and Testing Procedures for Aluminium and Aluminium Alloys for Aircraft (*B.S.*2 *L.*100 : 1961). *Price* 25*s.*

THIS British Standard — which now bears the reference 2 L.100, instead of L.100—was first published in 1951. Amendments made in 1953 and 1955 are incorporated in the new edition, with changes agreed between manufacturers and users in the light of experience gained in the use of the old edition.

The principal changes are: new tolerances are specified for the various forms of product covered by the standard; metric equivalents and tolerances are introduced, with requirements for their use; requirements for controlled stretching of bars and extruded sections are also introduced; and the head forming test for wires for rivets is replaced by a torsion test.

The revision of this important standard naturally means that the numerous related British Standards for aluminium alloys have also had to be brought up to date. The revision of these is still proceeding but the following new and revised standards, some of which replace specifications in the Ministry of Aviation D.T.D. series, have just been published at 2s. 6d. each.

4L16—99 per cent aluminium sheets (half hard). 4L17—99 per cent aluminium sheets (soft).

6L25 — Aluminium - copper - nickel - magnesium alloy forging stock and forgings (solution treated and aged). 4L42 — Aluminium-copper-magnesium-nickel-silicon forging stock and forgings (solution treated and precipitation treated).

2L54—99 per cent aluminium tubes (cold drawn) (tested hydraulically). 2L55 — Aluminium - 2 per cent magnesium alloy tubes (half hard). 2L56—Aluminium-2 per cent magnesium alloy tubes (soft).

2L59 — Aluminium - manganese alloy sheets and strips (three-quarters hard). 2L60 — Aluminium - manganese alloy sheets and strips (one-quarter hard). 2L61 — Aluminium - manganese alloy sheets and strips (soft).

2L63 — Aluminium - copper - magnesium - silicon - manganese alloy tubes (solution treated and precipitation treated).

2L67—99 per cent aluminium tubes (cold drawn) (not tested hydraulically).

2L70 — Aluminium - copper - magnesium - silicon - manganese alloy sheets and strips (solution treated and aged at room temperature). 2L71—Aluminium-copper - magnesium - silicon - manganese alloy sheets and strips (solution treated and precipitation treated). 2L72—Aluminium-coated aluminium-copper-magnesium - silicon - manganese alloy sheets and strips (solution treated and aged at room temperature). 2L73—Aluminium-coated aluminium-copper-magnesium - silicon - manganese alloy sheets and strips (solution treated and precipitation treated).

L80 Aluminium-2¼ per cent magnesium alloy sheets and strips (soft) (replacing D.T.D.634A). L81—Aluminium-2¼ per cent magnesium alloy sheets and strips (half hard) (replacing D.T.D.606A). L82—Aluminium-3½ per cent magnesium alloy sheets and strips (soft) (replacing D.T.D.180C).

L83—Aluminium-copper-nickel-magnesium-iron-silicon alloy forging stock, bars, extruded sections and forgings (solution treated and precipitation treated) (replacing D.T.D.130B). L84 — Aluminium - copper - silicon - magnesium alloy bars and extruded sections (solution treated and aged at room temperature) (replacing D.T.D.443A). L85 — Aluminium-copper-silicon-magnesium alloy forging stock - bars, extruded sections and forgings (solution treated and precipitation treated) (replacing D.T.D.423C).

Methods for the Sampling and Analysis of Tin and Tin Alloys (*B.S.*3338 : 1961). *Parts* 1, 2, 7, 11 *and* 12. *Price* 3*s. each, except Part* 2, 4*s.*

FIVE methods in a new British Standard series of methods for the sampling and analysis of tin and tin alloys have just been published. Another seven methods will be issued in due course.

The complete series is being published under the collective number and title, B.S.3338, "Methods for the Sampling and Analysis of Tin and Tin Alloys", but each part is being issued as a separate booklet.

The parts published so far are: Part 1—Sampling of ingot tin; Part 2—Tin in ingot tin (aluminium reduction method); Part 7—Silver (volumetric: ammonium thiocyanate method); Part 11—Tin in solders (nickel coil reduction method); and Part 12—Sampling of solders.

The methods are intended for the sampling and analysis of the grades of metal covered by B.S.3252, "Ingot Tin", B.S.218, "Soft Solders", and B.S.3332, "White Metal Bearing Alloy Ingots".

Part 1 specifies selection of ingots, preparation of surfaces, method of taking samples by means of sawing and precautionary measures against contamination of the samples.

Part 2 lays down a method for determining tin in ingot tin having a tin content from 99·0 to 99·8 per cent, Part 7 gives a method for determining silver in solders having a silver content of up to 3 per cent, and Part 11 contains a method for determining tin in solders having a tin content exceeding 1 per cent. Each of these three parts specifies reagents required, recommended methods of sampling and test procedure.

Part 12 specifies selection of ingots, bars, sticks or wire, preparation of sample, preparation of surfaces, methods of taking final samples by means of sawing or filing, and precautionary measures against contamination of the samples.

Copies of the above - mentioned standards may be obtained from the British Standards Institution, 2 Park Street, London, W.1.

Coal Tar Fuels

A NEW and wholly rewritten edition of the book, "Coal Tar Fuels", has now been published by the Association of Tar Distillers, 9 Harley Street, London, W.1. The first chapter describes briefly the production of coal tar in the coal carbonization process, then surveys generally the technique of coal tar distillation to give the valuable products and, finally, shows how the different coal tar fuels are prepared. Chapter 2 concerns the composition and properties of the fuels, and emphasizes particularly the importance of the carbon/hydrogen ratio and low sulphur content. In discussing the viscosity, it is pointed out that the fuels are, in fact, designated according to the temperature (°F.) at which the fuels reach viscosities suitable for atomization.

The combustion process is considered in Chapter 3, showing the theoretical amounts of air required for combustion of coal tar fuels, and the products resulting. Some interesting information follows on how a study of flame shape and flow patterns can be of practical use in improving furnace processes. Chapter 4 is valuable to chemical engineers concerned with designing the equipment for storing and handling the fuels. Several new nomograms have been worked out, based on practical data.

The many types of burners, pumps, valves, heaters and other auxiliary plant equipment recommended are described in Chapter 5. In the final chapter on "Applications", the suitability of coal tars fuels for open-hearth furnaces and other types of metallurgical plant, and for boiler plant and other purposes is demonstrated. The advantages originating from the low sulphur content and high flame emissivity in the particular use and the influence on fuel efficiency are stressed.

The price is one guinea.

Organic and Metallic Finishes

By R. J. BROWN, A.I.Mech.E., F.I.M.
(*Chief Materials Engineer, British Motor Corporation*)

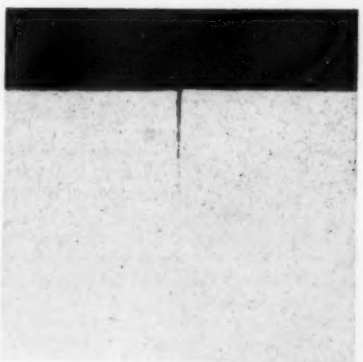
(*Concluded from* METAL INDUSTRY, 17 *March* 1961)

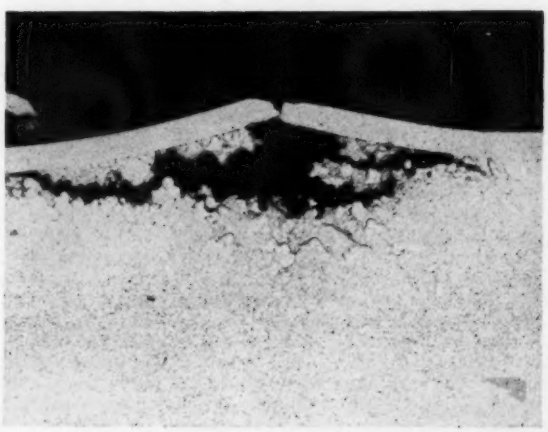
ON a motor car, metallic finishes are mainly electrodeposited metals, very little use being made of sprayed metal coatings. The bulk of the electrodeposited materials are applied to the decorative trim, and finish up as chromium plated items, although considerable use is made of electrodeposited zinc, and to a lesser extent of cadmium coatings to underbonnet fitments, and more particularly to nuts and bolts on the chassis construction which are subjected to violently corrosive conditions and where corrosion would interfere with the necessary maintenance of the vehicle or its performance.

Plated trim is based upon steel, zinc die-castings, or brass, although the amount of plated brass being used in these days is relatively small. In order to prevent corrosion of the basis metal, an adequate thickness of overlay is essential, as is the requirement of corrosion resistance of the overlay. Plated trim on the earliest motor cars had a top coat of polished nickel, but this required considerable care on the part of the owner to maintain reflectivity, as the surface was readily tarnished by atmospheric conditions, and more particularly by industrial atmospheres. Chromium plating was introduced in order to provide a tarnish-free surface, and this freedom from tarnish is undoubtedly one of the reasons why so many complaints are made of the inadequacy of plated trim items. With a nickel top-coat, constant cleaning ensured relative freedom from contaminating matter, but with chromium plating, cleaning by many owners is regarded as almost unnecessary, so that the surface of the part may be coated with an almost invisible deposit of grime containing a high proportion of impurities and capable of holding quite high proportions of moisture; thus the average owner virtually ensures the maintenance of an electrolyte over the whole surface of his bright trim (Figs. 26-28).

The early art of electrodeposition on steel involved the application of flash nickel, dull copper followed by buffing, and dull nickel followed by buffing. Owing to the danger of the electrodeposits being reduced very considerably in thickness in the polishing operations, relatively heavy coats were generally applied. With increasing demands on the electroplating industry and the increasing area of bright trim being applied to any particular motor car, improved methods of deposition became necessary, resulting in the introduction of bright nickel, and later of bright copper. Unfortunately, these developments brought in their train undesirable features such as highly stressed deposits and the danger of trapped non-metallic matter in the coatings, the former leading to cracking of the deposit and the latter producing a form of porosity, though such porosity could not be revealed by microscopic examination. The conventional chromium plating applied was also highly stressed, so that in order to prevent deterioration of the appearance by visible cracks, the thickness of the chromium deposit had to be kept at a minimum.

Of recent years, these undesirable properties of the coatings have been countered by the introduction of high levelling semi-bright nickel deposits. These are relatively free from stress, but require colouring prior to application of the chromium, with the associated dangers of thinning of the coating in the colouring operation and consequent local corrosion in service. Duplex nickel, involving the application of a levelling semi-bright nickel deposit followed by a fully bright coating without the necessity for colouring of the semi-bright deposit has been claimed as the answer to corrosion problems in the U.S.A. (Figs. 29 and 30). Service life in this country is, as yet, insufficient to make any excessive claims for its success, although laboratory tests imply that they are a considerable improvement over the previous single coat nickel deposits. Alongside the development of duplex nickel has been the development of so-called crack-free chromium deposits (Fig. 31) although these might better be described as "more crack-free". The advantage of this type of chromium deposit is that it can be applied in much heavier thicknesses without the development of serious cracking, so that the increased chromium thickness in itself provides an increased barrier to the corrosive influences encountered in service. Again, although very great claims are made for this form of chromium deposit in the U.S.A., experience in this country is as yet somewhat short and extends only over a period of some six to nine months. A further development of duplex chromium in America incorporates a crack-free chromium followed by an

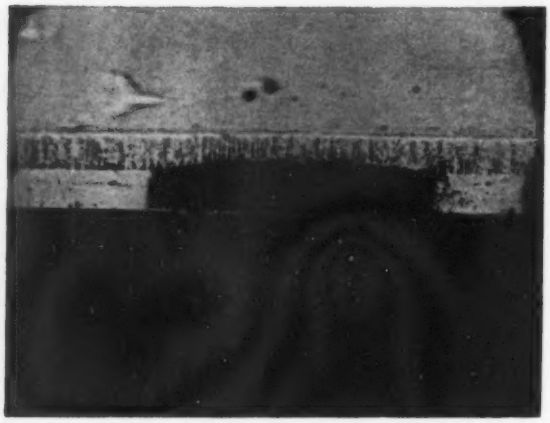


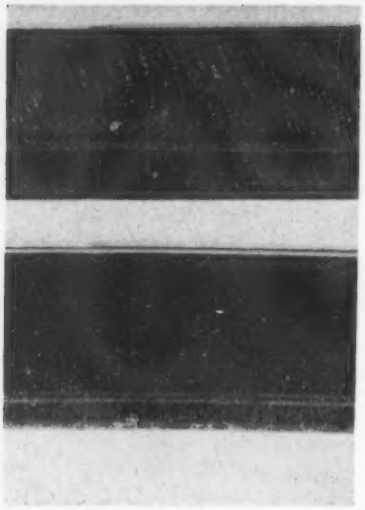


Above left: Fig. 26— Perforation of nickel through crack in chromium on zinc alloy die-casting

Above right: Fig. 27— Penetration into base metal on zinc alloy die-casting

Right: Fig. 28— Production of blisters by volume of corrosion product





Above left: Fig. 29—Penetration in normal nickel

Above right: Fig. 30—Duplex nickel

Left: Fig. 31—Cracked chromium, normal type

extremely heavily cracked chromium overlay, the theory being that if the electrolytic effects are distributed widely, as distinct from concentrated electrolytic attack at a few cracks, then perforation of the underlying nickel deposit will be very much slower and the overall life of the component considerably lengthened.

In the testing of electrodeposits, the only useful yardstick, once the process had been proved, was, in the past, the determination of coating thickness, necessitating destruction of the components or the coating when employing either the B.N.F. jet test, or microsectioning. Numerous magnetic and electrical methods have been employed from time to time, and of these probably the most successful has been the Magne-gauge, which depends upon the reduction in attraction between a small permanent magnet and the magnetic basis material by the interposing coating material, or the magnetic attraction of the nickel coating on a non-ferrous base. This instrument probably represents the optimum in this type of apparatus. A much simpler form of the apparatus is the B.S.A./Tinsley pencil thickness gauge in which the force required to separate the magnet from the coated surface is measured by means of a calibrated helical spring.

The thickness gauge recently produced by the British Non-Ferrous Metals Research Association depends upon thermo-electric effects. The application of a heated probe to the surface under test provides the hot junction of a thermo-couple, the base material resting on a heavy block of bronze being the cold junction, the meter measuring the potential difference existing between the base and the coating metals. The potential difference is calibrated in terms of coating thickness for the particular coating applied and the whole apparatus provides a ready means of non-destructively testing quite rapidly the coating thickness of nickel, or copper and nickel, applied to various basis materials.

Although thickness testing provides the most ready means of quality control in the plating shop and by the motor car manufacturer, the customer is only interested in service performance, or in other words resistance to corrosion, and to cover this aspect, which need not necessarily be related to coating thickness, various accelerated corrosion tests have been and still are employed, the earliest being the well known salt spray test.

Following the many complaints which have been levelled against the relationship between the results of the salt spray test and atmospheric corrosion, modifications have been made to it, largely as the result of work in the U.S.A. These include the acetic salt spray test which is now incorporated in the current edition of B.S.1224, and the CASS test.[5] The former is basically the salt spray test involving the use of a 5 per cent sodium chloride solution, to which is added approximately 1 per cent of acetic acid, with the temperature controlled throughout the test at 35 ±3°C. and with a specified rate of moisture precipitation on the specimens. The CASS test is a modification of the acetic salt spray test in that to the solution is added a small amount of cupric chloride (5·5 gm. per 5 gal.) and the test is conducted at a somewhat high temperature, 120 +2 −1°F. From the laboratory tests and outside weathering tests so far carried out, it would appear that the acetic salt spray test is more reliable than the original straight salt spray test in that corrosion is rapidly developed wherever there is a fault in the plated coating. Experience with the CASS test is so far somewhat limited, but there is some evidence that the results are unreliable, and that the corrosive conditions have probably been too much speeded up.

An additional test[7] developed in the U.S.A. is the "Corrodkote" test, in which a corrosive paste is applied to the surface of the part to be tested, then subsequently exposed to high temperature and high humidity, the endeavour being to simulate service conditions where the plated surface becomes fouled with atmospheric grime or with road grime. Experience in this country again is somewhat restricted on this particular test although it is quite a logical approach to the subject. In this country, the SO_2 test has been devised and is an excellent means of revealing cracked deposits in a very short time.

The modern motor car now incorporates a considerable area of polished stainless iron and of bright and anodized aluminium, with increasing use of plastics materials either metallized by vacuum coating or incorporating in their construction aluminium foil; these finishes, or more correctly finishers, are not necessarily free from either service or production troubles, but they have the advantage that with stainless iron any surface discoloration can be readily restored by polishing with a mild abrasive without destruction of any protective coating.

References

[6] W. L. Pinner; *Plating*, 1957, July.
C. F. Nixon, J. D. Thomas and D. W. Hardesty; *Proc. A.E.S.*, 1959, 159.

[7] W. L. Pinner; *Proc. A.E.S.*, 1956, **50**.

HIGH POLISH FOR DIE CAVITIES REDUCES SECTIONS AND ASSISTS FEEDING

Effects of Die Finishing

UNTIL recently, pressure die-casters and toolmakers for the pressure die-casting industry were not concerned with achieving a high finish on die-cavities. Indeed, there was a widely held belief that a very slight grain, similar to that obtained by fine vapour blasting, aided chilling of the metal by dragging slightly on the inflowing metal, causing a roll over of the metal stream, thus presenting a constantly new surface of metal to the die.

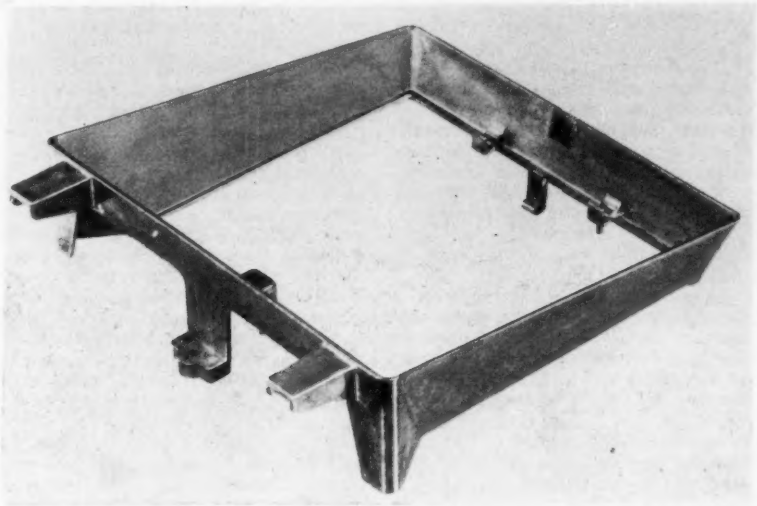
Some revision of this outlook took place a year or two ago, and one or two foundries began to aim at very high surface finish in the cavities. This technique was taken up in Italy, and many of the delegates to the Third International Die Casting Conference who visited the Ruffini foundry at Turin were interested in the high casting finish and the thin sections achieved. An example of recent development work in this country, using a similar approach, is given in this article.

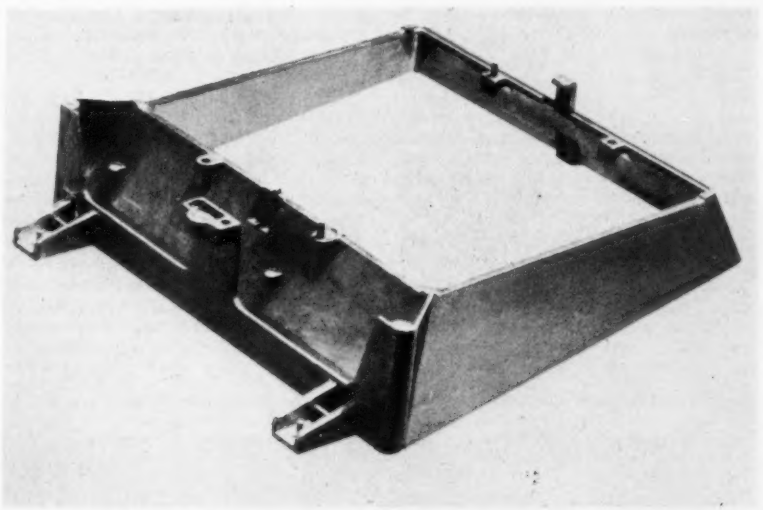
The casting concerned is a body for the new model of the G.E.C. toaster. Two of the castings, which are in LM6 alloy, form the major frame of the assembly. A feature of the casting is that it is so designed that two identical castings fit together by means of integral dowels and cast-in bolt holes. The complete assembly is thus achieved by means of one securing screw at the bottom. The cast-in brackets at the top locate and secure the element and guards; the final assembly is accomplished by the addition of two further screws. Integral legs are cast-in and provided with a cast-in peg which is riveted over to secure heat-insulating feet.

It will be observed from the illustrations that two rectangular bosses at the top of the body are provided respectively with a cast-in dowel and a hole of similar size. Two bosses at the lower edge of the inner aperture have similar provisions, so that when the two castings are placed back to back, the dowels and holes match up.

The casting itself is not of any extraordinary intricacy, but it is a fair example of the effects of die-finishing. Cast by Alloy Pressure Die Products Ltd., it weighs 6¼ oz. after trimming, and it is believed that in this case the high finish on the die cavity has enabled a weight saving of something approaching 20 per cent to be achieved.

One of the obstacles to special finishing of dies in this country has been the shortage of trained men capable of tackling the finishing operation. Like other foundries, Alloy Pressure had not specialized in obtaining this particular finish and decided to train two men specially for this work. Training for about six weeks was necessary. Die cavities are now copy milled in the usual way, riffled by hand, smoothed with successive grades of emery and oil-stones, and finally the cavity is finished with diamond lapping paste.





Pressure die-cast toaster body in aluminium alloy showing (above,) the outer surfaces, and (below) the casting reversed

In general, wall thicknesses in this casting are of the order of 0·060 in., instead of the $\frac{3}{32}$ in. that would be necessary without special die finishing.

The statement above may, at first, seem strange, but one of the advantages of the much smoother die surface is that it reduces friction between the injected metal and the die wall. Thus, for a given wall thickness less injection pressure is required, opening up new possibilities for casting on less powerful machines. Similarly, it permits the feeding of thinner sections than would otherwise be possible, even with higher pressure. To obtain the maximum advantage, it is also necessary to apply this high finish to the feed channels.

In the particular casting discussed here, the advantage of the finish on the casting itself is not fully appreciated, since the parts are sprayed, but where parts are to be polished and plated, further savings are effected. In a zinc letter plate, for example, not only has there been a weight reduction of 20 per cent, but polishing time has been considerably reduced, and because only slight buffing is necessary, the danger of removing the harder outer skin of the die-casting is considerably reduced.

ZINC ALLOY PRESSURE DIE-CASTING REDUCES PRODUCTION COSTS

Die-Cast Lighting Fixture Components

SUBSTANTIAL savings in production costs have been achieved by an American manufacturer of office and residential lighting equipment by switching from stamped sheet steel to die-cast zinc alloy, according to the American Zinc Institute. The conversion to zinc die-castings represents a material change virtually for the entire line of frames, canopies, bullet cones, swivel assemblies, and other lighting fixture components made by the company.

In one typical case—a recessed lighting fixture housing frame—the manufacturer has saved 30 per cent of the cost of the former sheet metal stamping by converting to zinc alloy die-castings. Reasons for the change-over include zinc's inherent ability to be die-cast to close dimensional tolerances "as cast", plus the ease and economy with which zinc can be attractively plated. This means that die-cast zinc parts can be produced rapidly, with dimensional consistency, and economically, since they require a minimum of machining and preparation operations to result in attractive, finished parts.

A typical die-cast zinc alloy frame consists of the main frame and two flaps. The frame has four integrally cast joining wall sections that replace tabs, riveted flap holders, and channels specified in the stamped steel design. The zinc unit is cast in a single-cavity die, and after trimming, the only secondary operation required is to punch four holes for spring attachments.

The flaps are cast in a multiple-cavity die and require no trimming; gates are simply broken off. No secondary machining operations are required. The only remaining steps are to clean, buff, and electroplate the flaps and main frame.

Other advantages of zinc alloy die-casting include a marked improvement in the product's appearance and more rigidity than when stamped. Also, in areas where appearance of the product is not important, no protection is needed since another advantage of zinc is its corrosion resistance.

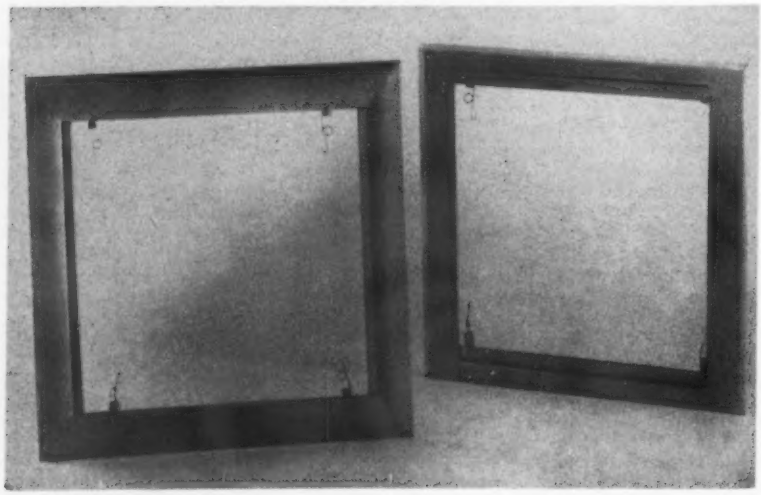
Originally, the frame was stamped out of pre-plated steel received from the mill with a protective paper cover. Fabrication with this material was a relatively expensive process that involved some 15 stamping and forming steps, plus additional assembly operations. The former production sequence was: stamp out frame, blank out square and bevel edges; fold down two tab sections; pierce two holes in each section; blank out and form two flaps, channels, and flap holders. Following these stamping and forming operations, assembly required additional steps such as: rivet flap holders to tabs on the frames (four rivets); and install channels and flaps. The adhesive protective paper was then stripped off the pre-plated stock and the surfaces cleaned.

Before converting to die-castings, the manufacturer made an alternative attempt to resolve production problems. Plating equipment was installed to cut down the high cost of pre-plated steel, and to overcome the problem of pre-plated stock not being protected at cut edges. The manufacturing operations were the same as with the plated stock, except that the bright finish cold-rolled steel had to be buffed and plated after fabrication. High cost of the many stamping, forming, and assembly operations remained a major problem. Production of this one assembly required seven individual stamping and forming tools, plus jigs, fixtures, and the time of various machine tools and presses.

As a result of marked production savings and improved product appearance and quality, the lighting fixture manufacturer has turned more and more to die-cast zinc parts for the entire line. Zinc alloy die-castings are employed for ten different basic frames (recessed round, square, and rectangular); ten types of round and rectangular canopies; four kinds of bullet cones; three types of swivel assemblies; as well as brackets, fittings and other parts.

The increased reliance on die-castings has shown up additional advantages of the material and process, compared with sheet metal. In many cases, desired features could not be obtained with stamping or spinning because of the restrictions imposed by the uniform thickness of sheet metal. The need for various attaching elements created other problems. With die-castings, integral mounting bosses and lugs eliminate the need for external assembly accessories. Self-tapping screws are especially adaptable to die-cast zinc; screw heads are easy to conceal.

Die-cast zinc (left) and stamped sheet steel (right) recessed lighting fixture frame



Burner Control

FOR safely igniting and monitoring multi-burner installations in industrial concerns, Ether Ltd., Caxton Way, Stevenage, Herts., have developed a new range of flame controllers. They are fully transistorized, with plug-in circuitry and A.C. coupled amplifier—for use with gas-fired and oil-fired burners or burners working on a combination of both fuels. They discriminate between flame and flame-radiation, being unaffected by the latter.

These controllers—Series 704—can be supplied for controlling up to six flames at once, depending on customers' needs. Each flame is controlled by a "flame-eye", comprising a lead-sulphide cell, and a transistor amplifier which is sensitive to the modulated component in the flame-radiation. The presence of the flame is indicated by an output signal from the transistor amplifier which, in turn, switches a silicon transistor.

The pilot relay, which interlocks with the flame relay and safe-start relay, cannot be energized until all the transistors are switched to "flame-on" positions. Absence of one or more flames will de-energize the pilot relay and indicate an alarm condition. If flame-failure occurs, the pilot valve and main valve close, the control valve closes to "low-fire" position, and the alarm signal is given.

Industrial News *Home and Overseas*

High-Purity Mercury

Following the installation of new equipment, **Johnson, Matthey and Co. Ltd.** announce that they are now able to offer in quantity two grades of mercury for laboratory and industrial use. Redistilled mercury has a maximum impurity content of 5 parts per million (mostly copper and silver), and triple-distilled mercury a maximum of 1 part per million. Every batch is examined spectrographically to ensure that the limits are not exceeded. The metal is supplied in 7 lb., 14 lb. or 28 lb. containers, though other packings can be provided.

The product is described in a newly issued data sheet in the electrical engineering series, 1300:492. Full details of prices and deliveries will be supplied on request to the company.

Induction Heating

One of their normal routine induction heating courses is to be held by **Pye Limited** on May 2 and 3 next at the Globe Hotel, Cambridge. The following subjects will be covered:—the fundamentals of induction heating, methods of application, the basis of coil design, hardening, annealing and tempering of small parts, brazing, soldering and processing of conducting materials.

The course is free of any charge, and full details may be obtained from Mrs. E. Raeburn, Pye Process Heating, 28 James Street, Cambridge.

Vitreous Enamelling Furnace

A new sheet, *Piped Heat*, published by the **North Western Gas Board,** which reports new uses of town gas by industry, devotes one of the articles in its current issue to a new type of vitreous enamelling furnace heated by a system of hermetically-sealed looped tubes within which hot gases are circulated at high velocity. By this system, uniformity of temperature and freedom from contamination of by-products of combustion within the furnace are ensured.

Aluminium and Oil Heaters

Use of aluminium in domestic apparatus is indicated in the "Slimline" oil heater made by a Darlington firm. In this heater a polished reflector, formed from a circle of 14⅛ in. diameter in commercially pure metal, supplied by the British Aluminium Company Ltd., forms an integral part of the lamp assembly and assists in protection from the harmful effects of draughts.

Industrial Finishing

Earls Court, London, is the venue of the first International Industrial Finishes Exhibition and Convention which is to be held from May 8 to 11 next. The exhibition will include finishing equipment, materials, plant and processes, incorporating metal pre-treatments, paints and their applications, electroplating, galvanizing, metal colouring, anodizing, plastics covering, vitreous enamelling, shot-blasting, vacuum deposition, instrumentation, and all the necessary ancillary equipment and processes for the finishing of industrial products.

For the Convention some 16 Papers are being presented, and it is proposed to organize works visits during the period of the event.

Metals in Defence

Speaking in the House of Commons last week, the Minister of Defence (Mr. Harold Watkinson) said that the proportion of the output of the metal-using industries now devoted to defence was about one-tenth, compared with one-ninth two years ago.

Annual Conference

It has been announced by the **Institute of Physics** and the **Physical Society** that the annual conference of its Electron Microscopy Group will be held from Monday, July 10, to Friday, July 14 next, at the University of Nottingham. The conference will be concerned mainly with the physics of the electron microscope and its applications.

Malayan Tin Shipments

According to the Straits Trading Company, tin shipments from Penang during the first half of March totalled 3,311¼ tons. They comprised nil to the United Kingdom, 20 to United Kingdom options, 1,216½ to the United States, 1,063 to the Continent, 100 to Canada, 557 to Japan, 14 to the Pacific, 261¾ to India, 68¼ to South America, nil to Africa, 10½ to Australasia, and 1 to the Middle East.

Tin shipments from Singapore in the first half of March amounted to 282¾ tons, comprising 100 to the United States, 145 to the Continent, 25 to Canada, 11¼ to the Pacific, 1¼ to India, and one-quarter to the Middle East.

Gauge and Tool Makers

At the next trade luncheon to be held by the **Gauge and Tool Makers' Association** at the Savoy Hotel, London, on Thursday, April 20 next, the guest of honour will be Sir Roger Makins, G.C.B., G.C.M.G., chairman of the United Kingdom Atomic Energy Authority.

Forty-nine senior executives, and the secretary of the association, will be taking part in a group visit to Moscow from May 27 to 31 next. The group will leave London Airport by B.E.A. Comet early on May 27 and return by Comet in the evening of May 31. The association has been formally advised by the State Scientific and Technical Committee of the U.S.S.R. Council of Ministers that adequate facilities will be made for the members of the group to visit Russian engineering factories and research institutions in the Moscow area.

Aluminium Suspension Clamp

A new design of aluminium suspension clamp for overhead transmission lines has been recently introduced by **Alcan Industries Limited.** It consists of two matching halves that, when brought together, enclose the conductor and grip it with the correct degree of tightness. Thus the clamp cannot be overtightened and damage to the conductor strands from this cause is eliminated.

The axis of the side trunnions is level with the conductor centre-line, which ensures that any pivoting motion will have the least possible effect upon the conductor, this being a requirement specified by the Central Electricity Generating Board.

Aluminium in Turkey

Recent news from Ankara states that the U.S. Reynolds Aluminium Corporation is reported to have submitted draft plans for the establishment of an aluminium plant to the Turkish Government. The project is estimated at 25 million dollars. Turkey has substantial bauxite deposits which are unused. Some of these are located in areas which are presently not readily accessible. It is, however, hoped that they will be opened up in the near future. It seems also doubtful whether the power supply is adequate, but a deficiency in this respect could be overcome, too.

As a matter of principle, the Turkish Government is interested in developing electrometallurgical industries. An electrolytic copper plant is under construction in Istanbul and a ferro-chromium plant is being set up in co-operation with a French group.

End Quench Unit

Recently introduced by **Metallurgical Services,** a new end quench unit is being introduced to industry. This apparatus has been designed to be universal in that interchangeable specimen holders are available for specimen diameters from 1 in. to ½ in. For these sizes the standard ½ in. diameter jet is accepted as satisfactory, but the jet is changeable so that if it is desirable to test specimens smaller than ½ in. diameter, a smaller jet may be fitted.

The makers stress that this unit may be applied with equal gain to non-ferrous alloys such as aluminium bronzes, also to those where a single phase precipitates. Another application is in assessing the quench sensitivity of precipitation hardening alloys. In a somewhat similar manner, quench hardened bars of steel may be subjected to various tempering treatments to determine the effect on hardness and microstructure.

Production Technology

A new course in production technology is to be offered at the **Borough Polytechnic,** London, next term. This is an intensive eight-weeks' course for qualified engineers, and is designed to provide practical and theoretical training in production technology for graduates who would like to supplement their academic knowledge and obtain an understanding of practical engineering production.

The course will last from May 1 next to Friday, June 23, and the fee is £7. Full details and application form may be obtained from the secretary, Borough Polytechnic, Borough Road, London, S.E.1.

Corrosion Prevention

A special exhibition on metallic corrosion and its prevention will be open to the public from noon on Monday,

Mr. Horace Cawley receiving an engraved gold watch in recognition of 25 years' service with the Union Carbide organization. Mr. Ray Wilson is making the presentation

March 27, to 6 p.m. on Saturday, April 22 next, at the Science Museum, South Kensington, London, S.W.7.

This collection of exhibits relating to corrosion and preventive measures has been assembled by the Corrosion Group of the Society of Chemical Industry to mark the First International Congress on Metallic Corrosion, which is being held in London from April 10 to 14.

A Presentation

At a ceremony in Union Carbide's head office in London recently, **Mr. Horace Cawley,** Sheffield area sales manager of the company's Alloys Division, was presented with an engraved gold watch in recognition of 25 years' service with the organization. Our photograph shows Mr. Cawley receiving the watch from Mr. Ray Wilson, director and general manager of the Alloys Division.

British Distributors

It is understood that the **Fuller's Earth Union Limited,** a member of the Laporte group, have concluded an agreement with the Archer-Daniels-Midland Company of New York to act as sole distributor for sales of "Federal Green Bond" bentonite in the United Kingdom, including Scotland and Ireland.

This bentonite, like the existing "Fulbond", will be backed by comprehensive technical service from the company with its long experience of the role of clay bonds in foundry moulding sands.

Arc-Furnace Transformers

News from the Transformer Division of **Associated Electrical Industries Ltd.** is that the company has received an order from Birlec-Efco (Melting) Ltd. covering two 35 mVA arc-furnace transformers to be installed at the Tinsley Park works of English Steel Corporation Ltd.

The transformers will be designed and manufactured at the AEI Rugby works. Each will supply power to a Birlefco arc furnace of one hundred tons capacity, with a 22 ft. diameter shell, rotatable about its vertical axis through an angle of 30 deg. on either side of its mean position. The shell bottom will be of non-magnetic steel in order to permit the use of a stirrer of the electro-magnetic type.

These transformers will operate on a 33 kV, 3-phase, 50-cycle supply and will transform this voltage down to a range of furnace voltages, these voltages being variable on load by means of A.E.I. resistor-transition tap changers under the control of the furnace operator. The maximum rated current of each of the furnaces will be approximately 40,130 amperes.

Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week were unchanged at 9,990 tons, comprising London 4,291, Liverpool 3,697, and Hull 2,002 tons.

Copper stocks fell 250 tons to 15,265, distributed as follows: London 1,125, Liverpool 12,165, Birmingham 100, Manchester 1,825, and Hull 50 tons.

Lead duty-free stocks rose 485 tons to 7,039 tons, comprising London 7,014 and Avonmouth 25 tons. In bond stocks were unchanged at 3,867 tons, all supplies in London.

Zinc duty-free stocks rose 519 tons to 3,258 tons, while in bond stocks were unchanged at 300 tons, comprising London duty-free 1,418 tons and in bond 300 tons, Liverpool duty-free 1,825 tons, and Glasgow duty-free 15 tons.

Induction Heating

Arrangements have been made whereby the servicing of English Electric radio-frequency induction heaters will be taken over by **Delapena and Son Ltd.** as from June 1 this year. This follows the cessation by English Electric of activity in the R.F. heating field.

It is also stated that Delapena are shortly introducing a new service maintenance contract scheme which they believe will prove extremely attractive to all users of their induction heating equipment. They intend to make the facilities of this scheme available also to users of English Electric equipment after June 1.

London Agents

It has been announced that **K. A. Ballard Ltd.** have been appointed London agents for the Clyde Structural Iron Company Ltd., who supply structural steel and other plate work as well as roofing, bridging and similar components. This appointment is principally directed to supplying the petroleum, petrochemical and chemical industries here and abroad.

Technical Films

A catalogue of their technical film library has been produced by the **International Wrought Non-Ferrous Metals Council.** This catalogue lists 23 motion films which deal with the production and uses of copper. The films are available on loan, free of charge, to anyone interested in copper.

Full details regarding these films may be obtained from the Council at 6 Bathurst Street, London, W.2.

Aluminized Asbestos Cloths

A leaflet has been distributed by **Turner Brothers Asbestos Company Ltd.** which sets out the particular virtues of their aluminized asbestos cloth. Into this leaflet is fitted a sample of quality KST.317 aluminized asbestos.

This asbestos is said to be easily installed and is usually applied over primary insulation or fabricated into mattresses, but it may be used by itself in miscellaneous situations to afford heat protection to equipment or personnel. This material is non-absorbent, and protects lagging from damage by water and the fire hazards of oil-spills.

Tinplate Statistics in the U.S.A.

Tin used in the manufacture of tinplate in the United States increased 32 per cent in 1960, reports the Bureau of Mines, U.S. Department of the Interior. Total use of tin by the tinplate industry was 33,363 long tons in 1960 compared with 25,390 in 1959. Tinplate production rose 1·5 million short tons and reached an all-time high of 6·3 million tons despite sharply-curtailed mill operations during the closing months of 1960.

Of the total output of tinplate, electrolytic represented about 92 per cent (91 per cent in 1959) and hot-dipped 8 per cent (9 per cent in 1959).

Tinplate exports—increasing for the first time in four years—totalled 504,940 long tons (328,900 in 1959). Tinplate imports—mainly from the U.K. and Canada—were 17,565 long tons, against 59,780 in 1959; except for 1959, this was the highest since 1913. Tinplate scrap imports totalled 36,400 tons, compared with 37,150 in the previous year.

Chilean Copper

News from Santiago states that Chilean copper production by the large mining companies in February totalled 40,141 tons the Copper Department announces. This compared with 42,244 tons in January and 39,313 tons in February, 1960.

Lead-Zinc Agreement

It is reported from Mexico City that the signing of an international agreement on lead and zinc for regulating production, consumption and prices, was proposed at the third meeting of the International Study Group for those metals. Senor Antonio Carrillo Flores of Mexico, President of the Group for 1961, advanced the idea at the opening session before delegates of 24 countries who produce or buy lead and zinc.

Senor Carrillo said the sudden fluctuation of prices for both metals was harmful for producing and exporting countries. He suggested that delegates should

seriously consider proposing to their respective Governments the establishment of an inter-governmental agreement to achieve maximum stabilization of the market. The high level of lead stocks was causing a drop in prices, he added. Canada had announced its intention to reduce lead production in 1961 and Mexico was also willing to join in any fair measures for reducing world production.

The zinc situation was, he said, "different". Use of that metal showed a constant increase which had not been seriously harmed by the use of substitutes such as plastics, which were affecting lead. Despite reduced demand in the United States, zinc consumption had kept pace with production, which explained why prices maintained their stability. Senor Carrillo proposed that Denmark be accepted as a member of the Group.

Aluminium from Clay

According to reports from New Haven (Conn.), U.S.A., Olin Mathieson Chemical Corporation has announced it believes it can produce aluminium from ordinary clay as cheaply as from bauxite. Plans were under way to evaluate the process further, said Dr. W. E. Hanford, the company's vice-president for research. "Preliminary laboratory work has been very encouraging. Production costs of the process are competitive."

The company said it would spend well in excess of $50,000 "verifying" its development. It gave no time period for commercialization of the process nor would it disclose where or when it would build a plant to utilize it. The new process enabled alumina to be extracted from clay or coal shale by separating aluminium sulphate from these raw materials; sulphuric acid was the starting material. The new process, the company said, would reduce the number of steps in the production of alumina.

Olin Mathieson would not estimate the cost of the new process. It would be competitive with conventional techniques, Dr. Hanford said. At present, the cost of making a ton of alumina using the present technique was $50 to $55; this included shipping costs of bauxite.

Visiting U.S.A.

Leaving today (Friday) by air for San Francisco for a business tour of the United States, Dr. E. S. Hedges, D.Sc., Ph.D., F.R.I.C., F.I.M., will be meeting representatives of tin consuming industries in the country. He will talk with them on those aspects of the work of the **Tin Research Institute** in which they are particularly concerned. He will also visit a number of American universities to view their research facilities.

Dr. Hedges will include visits to Los Angeles, New Orleans, Baton Rouge, Cincinnati and New York. He will also visit Columbus, Ohio, for conferences at the American office of the Tin Research Institute.

Vacuum Pressure Pump

It is announced that **Edwards High Vacuum Ltd.** have been appointed sole United Kingdom and British Commonwealth agents for the new "Reciprotor" combined vacuum pressure pump manufactured in Denmark.

Operated by an electromagnetic vibrator from an A.C. supply, the pump is stated to be unique in a number of features, including its very compact design, a weight of only 10 lb., and a completely oil-free air delivery as no lubrication is necessary. This pump is available in two versions. The type 406G is designed for continuous operation and provides a free air displacement for 1·62 ft^3/min., a vacuum of 18 in. Hg and a maximum pressure of 7·8 lb/in^2. The type 606G is rated for intermittent operation only, but has an improved performance, delivering air at 1·77 ft^3/min. and attaining a vacuum of 22 in. Hg and a maximum pressure of 10·7 in^2.

Birlec Furnaces

An agreement has been made between **AEI-Birlec Limited** and Major Electric Furnaces Pty. Ltd., of Melbourne, Australia, for the setting-up in Melbourne of a new company to be known as Birlec-Major Pty. Ltd. Offices of Birlec-Major Pty. Limited will be situated in Chesterville Road, Moorabbin, Melbourne.

Birlec-Major Pty. Ltd. will manufacture every type of electric and gas-fired furnace, for heat-treatment and melting processes, at present built by Birlec and their associate companies in the U.K. In addition to serving the Australian market, the new company intend to market their products in New Zealand and S.E. Asia.

Scrap Metal Shortage

A general shortage of scrap metal in this country made it evident that we could not afford to export scrap metals. This fact was stated at the annual meeting in Birmingham, on Tuesday last, of the **British Bronze and Brass Ingot Manufacturers' Association** by its President, Mr. James H. Barwell. It seemed clear, said Mr. Barwell, that prices of metals and scrap in many countries, even apart from Japan, were still subject to political and fiscal policies, meaning that to open our doors to scrap exports would submit this country to unfair competition. The Board of Trade, it was said, continued to weigh the scrap export problem very carefully.

With reference to ingots, the President said that the export of ingots had continued at a good rate after falling off in the third quarter of last year, although the 1960 total overall was slightly lower at 29,422 tons.

Mr. Barwell (Allcock and Co. (Metals) Ltd.) was re-elected President for the ensuing year, and Mr. J. N. Cohen (A. Cohen and Co. Ltd.) re-elected vice-president of the association.

Esso Board Appointments

After completing a year's assignment with the Standard Oil Company (New Jersey) in New York, Mr. E. F. Choppen will rejoin the board of directors of **Esso Petroleum Company Limited** on April 4 next. It is also announced that Mr. L. B. Johnson has been appointed a director of the company, effective from the same date.

Personal

Deputy chairman of Metal Industries Limited, **Mr. John Black** has now been appointed, in addition, managing director of the company. **Mr. Wilfred Padley** has been appointed deputy managing director. Mr. Black joined the company as chief accountant in 1951 and was placed on the board in the following year. Mr. Padley joined the group in 1956 and was managing director of Brookhirst Igranic, a subsidiary, prior to his appointment to the board of the parent company in 1960.

The board of G.K.N. Steel Company Limited announce the appointment of **Mr. C. F. Pagnamenta,** O.B.E., as a director. Mr. Pagnamenta remains as secretary of the company. The company also announce the following appointments as local directors: **Mr. A. T. Harris,** chief engineer of Brymbo Steel Works. To Guest, Keen Iron and Steel Works Board: **Mr. T. Dennison,** group development officer.

Agreement on Resin Materials

By a newly completed agreement, **British Insulated Callender's Cables Limited** will act as distributors to the electrical industry in Great Britain and Northern Ireland of fibre-reinforced resin materials manufactured by Thermotank Plastic Engineering Limited, Chapelhall, Lanarkshire.

The agreement is the outcome of several years of collaboration between the two companies to develop reinforced plastic materials which combine high insulation performance with great tensile strength. This has resulted in the production, by a continuous process of extrusion or of combined extrusion and lamination, of tubes and solid sections in various sizes and profiles in fibre-reinforced synthetic resins. These are already proving valuable in solving problems where high electrical and mechanical stresses occur.

Among the applications in which the material offers substantial advantages are stay-wire insulators, operating rods and bars for switchgear. It also has a growing use and great potential in overhead lines for power distribution and traction systems, including tension members, section insulators and support arms. Metal terminal fittings which enable the great tensile strength of the material to be exploited have been developed and patented. Both companies are continuing a joint development programme directed towards the special requirements of the electrical industry.

M.F.A. Meeting

At a meeting of the **Metal Finishing Association** in Birmingham on Tuesday last, Mr. A. E. J. Pettet, assistant director of the Water Pollution Research Laboratory, addressed the members on the subject of water conservation and purification in the metal finishing industry. After dealing with the sources of waste waters, their composition and the need for the separation of cyanide wastes before treatment, Mr. Pettet suggested that the installation of drag-out tanks would go far to solve the problems of most platers.

Forthcoming Meetings

March 28—Institution of Plant Engineers. Glasgow Branch. Scottish Building Centre, 425 Sauchiehall Street, Glasgow. "Recent Developments in Handling and Firing of Domestic and Industrial Boiler Plants." R. Clelland. 7.15 p.m.

March 28—Institute of Metal Finishing. South West Branch. Assize Courts Hotel, Bristol. Open Forum. 7.30 p.m.

March 30 — Institution of Production Engineers. Wolverhampton Section. Star and Garter Hotel, Victoria Street, Wolverhampton. "Modern Trends in Metal Removing Techniques." J. Cherry. 7.15 p.m.

Metal Market News

IN spite of the untoward events at the Prime Ministers' conference, leading to an announcement that the Union of South Africa was no longer in the Commonwealth, a decidedly cheerful tone was in evidence both on the Stock Exchange and in Whittington Avenue. Wall Street, too, staged a recovery in spite of the fact that the general situation in the United States does not, as yet, show much, if any, improvement. On the Metal Exchange, turnovers were up to average and, without exception all the metals gained ground although the improvement in zinc was only small. Sentiment in copper was slightly dashed by the Copper Institute figures, details of which are appended, but there was an improvement at the end of the week and the close was firm. As usual, the statistics are set out in terms of short tons, and the month concerned is, of course, February. Inside the United States, production of crude copper was 95,577 tons against 108,385 tons in January, while the output of refined metal at 134,812 tons was nearly 10,000 tons below the January total. Deliveries dropped from 99,794 tons to 93,029 tons, while stocks of refined copper in producers' hands rose by 3,667 tons to 147,799 tons. Outside the States, crude production dropped by about 7,000 tons to 192,081 tons and refined output by 4,000 tons to 169,968 tons. Deliveries were also lower in February, the comparison being 194,457 tons against 211,749 tons. Stocks were up quite a bit at 308,692 tons, which compared with 292,776 tons at the end of January.

The total increase in world stocks, therefore, was not much short of 20,000 tons in spite of the measure of curtailment which has been instituted by the producers. This is not inconsiderable, but whether it is enough has always seemed rather doubtful. Deliveries to consumers, as shown in the figures above, are rather disappointing, even though one remembers that February is a short month. Particulars of the Metal Exchange warehouse stocks were, as usual, available at the beginning of last week, and they show that copper reserves went up by 125 tons to 15,515 tons, while the tin tonnage dropped by 29 tons to 10,007. The stocks of lead rose by 26 tons to 10,473 tons, but reserves of zinc were 360 tons down at 3,039 tons. The warehouse stocks of zinc are decidedly unsatisfactory, and it is not remarkable that a backwardation is in existence; the only wonder is that it is not greater than it is.

As to the trading in zinc, last week saw a turnover of about 8,600 tons on a steady market in which price fluctuations were not wide. Finally, the close was £85 15s. 0d. cash and £84 10s. 0d. three months, these quotations registering gains of 5s. and 10s. for the respective positions. Lead was active last week, about 10,000 tons changing hands. much of the buying being due to optimism about the conference in progress this week in Mexico City. At the close, cash was up £1 17s. 6d. at £67 17s. 6d., and three months £1 15s. 0d. up at £69. The tin market was very firm, advancing £8 10s. 0d. for cash to £817 10s. 0d., and £7 for three months to £819. About 1,000 tons changed hands. In copper, the turnover was 11,600 tons, cash closing £2 5s. 0d. up at £236 10s. 0d., and three months £2 higher at £227 15s. 0d.

Birmingham

Industrial activity is maintained at a high rate throughout the Midlands area. There is a good demand for non-ferrous castings and rolled metal. Night shift working has been resumed at one of the big Coventry motor works, and another encouraging sign is that another firm of bodybuilders is taking back some of its workers made redundant at the end of last year. The boom in the building industry continues. Reconstruction of business premises in several of the large towns in the area is not only providing work for direct contractors but for the many firms involved in inside furnishings. Prospects are good for many months ahead.

Iron and steel works continue well employed. Activity is maintained in the engineering industries, and there is a sustained demand for strip, small bars and sections. Substantial tonnages of heavy joists and sections are being used by building contractors over a wide area. Production of iron castings is expanding, consistent with the return to near normal working in the motor Industry. Foundrymen, however, have a great deal of work on hand for other branches of the engineering trades. There is no difficulty in obtaining adequate supplies of foundry iron. Pressure is strong for basic iron for steel production.

New York

Copper futures were stronger at the week-end on covering and other buying in active dealings. Some traders said the technically tight nearby positions, with indications of a squeeze, were an important reason for the advance. Physical copper was about unchanged, quiet among dealers, fair in the custom smelters sector and moderately active among producers. An Anaconda company source said that shipments of copper were still being seriously hampered by the strike at San Antonio and Antofagasta. Tin was very steady but quiet. Lead and zinc were quiet. In late dealings, tin was quiet and barely steady. Scrap copper was unchanged.

The platinum market continued its dull pattern during the week ended March 16. Consumption and demand were extremely limited. Primary sellers held to their officially published offered levels of $82-$85 per troy ounce, depending upon quantity, while outside market dealers were offering platinum at $80, and in some cases as low as $79.50.

The Kaiser Aluminum and Chemical Corporation announced it will construct a plant to manufacture tabular alumina at its Baton Rouge, Louisiana works. The construction of the new plant will increase fivefold the corporation's capacity to produce tabular alumina, and will mark the latest stage in Kaiser Aluminum's programme to expand facilities for special alumina products at the Baton Rouge works, it was stated.

Paris

Latest figures published in France show important increases in aluminium production and also bauxite production. First fusion aluminium production average for 1959 was 14·4 tons/month. In 1960, the figures for November and December respectively were given as 21·6 tons and 21·1 tons. Second fusion remained stable with an average monthly production in 1959 of 3·7 tons and the same figure for November 1960. December figures are not available as yet. Average monthly exports in 1959 were 4·5 tons. In 1960 they developed to over six tons.

Bauxite production monthly average in 1959 was 145·5 tons. This increased to 167·4 in December 1960. Exports remained stable, round 23 tons/month.

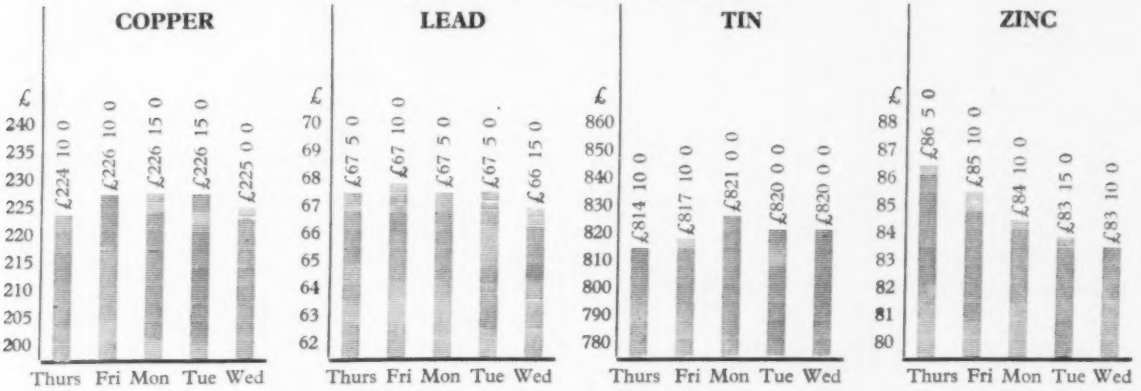
The position of the Alsatian potash mines continued to improve during 1960. Exports to the French Community countries increased continuously and the sales of the Alsatian Potash Company increased by 4·41 per cent. Foreign exports amounted to 726,679 tons, which is one-quarter of world exports.

The French metal company, Forges de Strasbourg, has announced that it had reached agreement with the E. F. Hauserman Company, at Cleveland, Ohio, for joint operations in Europe and Africa. Under the agreement, a new plant will be built in Koenigshoffen to produce sliding panels. The plant, which will cost some $1,400,000, is scheduled to start production in October 1962. In the meantime, Forges de Strasbourg will manufacture Hauserman products with "semi-products" imported from the United States. The new plant will be operated by a joint subsidiary company, to be called "Straforhauserman" on a fifty-fifty basis, and is expected to produce goods worth 30,000 000 new francs per annum, the company said.

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 16 March to Wednesday 22 March 1961



Primary Metals

All prices quoted are those available at 2 p.m. 22/3/61

		£	s.	d.
Aluminium Ingots	ton	186	0	0
Antimony 99·6%	„	217	10	0
Antimony Metal 99%	„	210	0	0
Antimony Oxide Commercial	„	194	10	0
Antimony White Oxide	„	196	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		11	0
Calcium	„	2	0	0
Cerium 99%	„	15	0	0
Chromium	„		6	11
Cobalt	„		12	0
Columbite	per unit		8	10	0
Copper H.C. Electro	ton	225	0	0
Fire Refined 99·70%	„	224	0	0
Fire Refined 99·50%	„	223	0	0

		£	s.	d.
Copper Sulphate	ton	77	0	0
Germanium	grm.		—	
Gold	oz.	12	10	7
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	66	15	0
Magnesium Ingots	lb.			
99·8%	„		2	2½
99·9+%	„		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		5	6
Alloy Ingot, AZ91X		1	11½-2	1½
Manganese Metal	ton	280	0	0
Mercury	flask	69	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.	20	0	0
Osmiridium	„		—	

		£	s.	d.
Palladium	oz.	9	0	0
Platinum	„	30	5	0
Rhodium	„	46	0	0
Ruthenium	„	16	0	0
Selenium	lb.	2	6	6
Silicon 98%	ton	122	0	0
Silver Spot Bars	oz.		6	7½
Tellurium Sticks	lb.	2	0	0
Tin	ton	820	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	83	6	3
Dust 95/97%	„	125	0	0
Dust 98/99%	„	131	0	0
Granulated 99+%	„	108	6	3
Granulated 99·99+%	„	123	8	9

**Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg≏£/ton	**Canada** c/lb≏£/ton	**France** fr/kg≏£/ton	**Italy** lire/kg≏£/ton	**Switzerland** fr/kg≏£/ton	**United States** c/lb≏£/ton
Aluminium		26.00 210 12	2.43 179 11	370 216 1	2.50 210 5	26.00 207 4
Antimony 99.0			2.30 170 0	500 292 0		29.00 231 2
Cadmium			15.75 1,069 0			150.00 1,195 10
Copper						
Crude				430 251 2		
Wire bars 99.9						
Electrolytic	31.00 226 11	27.50 222 15	3.15 232 15		2.75 231 5	29.00 231 6
Lead		10.00 81 0	.96 70 18	164 96 15	.78 65 11	11.00 87 13
Magnesium						
Nickel		70.00 567 0	9.00 665 2	1,180 689 2	7.50 630 15	74.00 589 15
Tin	113.75 831 7		11.61 843 3	1,530 893 10	9.65 811 11	103.87 827 16
Zinc						
Prime western		12.25 100 4 0				
High grade 99.95		12.85 104 17 0				
High grade 99.99		13.25 107 6 0			1.10 92 10	
Thermic			1.20 88 13			
Electrolytic			1.28 94 13	191 111 10		13.00 104 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 22/3/61

	£	s.	d.
Aluminium Alloy (Virgin)			
B.S. 1490 L.M.5 .... ton	210	0	0
B.S. 1490 L.M.6 .... „	202	0	0
B.S. 1490 L.M.7 .... „	216	0	0
B.S. 1490 L.M.8 .... „	203	0	0
B.S. 1490 L.M.9 .... „	203	0	0
B.S. 1490 L.M.10.... „	221	0	0
B.S. 1490 L.M.11.... „	215	0	0
B.S. 1490 L.M.12.... „	223	0	0
B.S. 1490 L.M.13.... „	216	0	0
B.S. 1490 L.M.14.... „	224	0	0
B.S. 1490 L.M.15.... „	210	0	0
B.S. 1490 L.M.16.... „	206	0	0
B.S. 1490 L.M.18.... „	203	0	0
B.S. 1490 L.M.22.... „	210	0	0
Aluminium Alloys (Secondary)			
B.S. 1490 L.M.1 .... ton	171	0	0
B.S. 1490 L.M.2 .... „	174	0	0
B.S. 1490 L.M.4 .... „	180	0	0
B.S. 1490 L.M.6 .... „	181	0	0
***Aluminium Bronze**			
BSS 1400 AB.1..... ton	245	0	0
BSS 1400 AB.2..... „	253	0	0

	£	s.	d.
***Brass**			
BSS 1400-B3 65/35 .. ton	177	0	0
BSS 249 ..... „		—	
BSS 1400-B6 85/15 .. „	224	0	0
***Gunmetal**			
R.C.H. 3/4% ton .... „		—	
(85/5/5/5) LG2 ..... „	221	0	0
(86/7/5/2) LG3 ..... „	231	0	0
(88/10/2/1) ..... „	284	0	0
(88/10/2/½) ..... „	294	0	0
***Manganese Bronze**			
BSS 1400 HTB1..... „	196	0	0
BSS 1400 HTB2..... „	213	0	0
BSS 1400 HTB3..... „	232	0	0
Nickel Silver			
Casting Quality 12% „	240	0	0
„ „ 16% „	255	0	0
„ „ 18% „	295	0	0
***Phosphor Bronze**			
B.S.1400P.B.1.(A.I.D. released) ..... „	311	0	0
B.S. 1400 L.P.B.1 „	242	0	0

**Average prices for the last week-end.*

	£	s.	d.
Phosphor Copper			
10% ..... ton	256	0	0
15% ..... „	260	0	0
Phosphor Tin			
5% ..... „	898	0	0
Silicon Bronze			
BSS 1400-SB1 ..... „	287	0	0
Solder, soft, BSS 219			
Grade C Tinmans ... „	377	10	0
Grade D Plumbers .. „	302	0	0
Grade M ..... „	415	5	0
Solder, Brazing, BSS 1845			
Type 8 (Granulated) lb.		—	
Type 9 „ „		—	
Zinc Alloys			
BSS 1004 Alloy A .. ton	116	18	9
BSS 1004 Alloy B.... „	120	18	9
Sodium-Zinc ..... lb.		2	7

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium			
Sheet 10 S.W.G. lb.	2	10½	
Sheet 18 S.W.G. „	3	0½	
Sheet 24 S.W.G. „	3	3½	
Strip 10 S.W.G. „	2	10½	
Strip 18 S.W.G. „	2	11½	
Strip 24 S.W.G. „	3	1	
Circles 22 S.W.G. „	3	4½	
Circles 18 S.W.G. „	3	3½	
Circles 12 S.W.G. „	3	2½	
Plate as rolled ..... „	2	10	
Sections ..... „	3	4	
Wire 10 S.W.G. .... „	3	1½	
Tubes 1 in o.d. 16 S.W.G. ..... „	4	4	
Aluminium Alloys			
BS1470. HS19W.			
Sheet 10 S.W.G. „	3	3	
Sheet 18 S.W.G. „	3	5½	
Sheet 24 S.W.G. „	4	1	
Strip 10 S.W.G. „	3	3	
Strip 18 S.W.G. „	3	4½	
Strip 24 S.W.G. „	4	0½	
BS1477. HP30M.			
Plate as rolled ..... „	3	1	
BS1470. HC15WP.			
Sheet 10 S.W.G. „	4	3	
Sheet 18 S.W.G. „	4	8½	
Sheet 24 S.W.G. „	5	8½	
Strip 10 S.W.G. „	4	4	
Strip 18 S.W.G. „	4	8½	
Strip 24 S.W.G. „	5	4½	
BS1477. HPC15WP.			
Plate heat treated ... „	3	10½	
BS1475. HG19W.			
Wire 10 S.W.G. „	4	2	
BS1471. HT19WP.			
Tubes 1 in. o.d. 16 S.W.G. ..... „	5	5	
BS1476. HE19WP.			
Sections ..... „	3	4	
Split tube			
19 S.W.G. (⅛") ..... „	4	2	
20 S.W.G. (⅜") ..... „	3	11	
21 S.W.G. (⅜") ..... „	4	1	
22 S.W.G. (¼") ..... „	4	11	
Welded tube			
14 to 20 S.W.G. (sizes ½" to 1½") .... „	3/10½ to 5/8½		

Brass			
Tubes ..... lb.	1	9⅜	
Brazed Tubes ..... „	3	2⅜	
Drawn Strip Sections „	3	2¼	
Sheet ..... ton	200	5	0
Strip ..... „	200	5	0
Extruded Bar ..... lb.	2	0½	
Condenser Plate (Yellow Metal)..... ton	186	0	0
Condenser Plate (Naval Brass)..... „	198	0	0
Wire ..... lb.	2	8½	
Beryllium Copper			
Strip ..... „	1	4	11
Rod ..... „	1	1	6
Wire ..... „	1	4	9
Copper			
Tubes ..... lb.	2	1⅞	
Sheet ..... ton	259	5	0
Strip ..... „	259	5	0
H.C. Wire ..... „	277	5	0
Cupro Nickel			
Tubes 70/30 ..... lb.	3	5⅞	

Lead			
Pipes (London) ..... ton	107	0	0
Sheet (London) ..... „	104	15	0
Tellurium Lead ..... „	£6 extra		
Nickel Silver			
Sheet and Strip 10%.. lb.	3	10½	
Wire 10% ..... „	4	3½	
Phosphor Bronze			
Wire ..... „	4	1	
Titanium (1,000 lb. lots)			
Billet 4½" to 18" dia..... lb.	47/-	48/-	
Rod ½" to 4" dia..... „	85/-	53/-	
Wire ·036"-232" dia.... „	159/-	99/-	
Strip ·001" to ·048".... „	350/-	68/-	
Sheet 8'×2'. 20 gauge „	73/-		
Tube, representative average gauge ..... „	198/-		
Extrusions ..... „	90/-		
Zinc			
Sheet ..... ton	122	0	0
Strip ..... „	nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 21/3/61.

	£
Aluminium	
New Cuttings	141
Old Rolled	114
Segregated Turnings	79
Brass	
Cuttings	160
Rod Ends	143
Heavy Yellow	136
Light	131
Rolled	149
Collected Scrap	135
Turnings	137
Copper	
Wire	206
Firebox, cut up	203
Heavy	201
Light	198
Cuttings	208
Turnings	184
Braziery	177

	£
Gunmetal	
Gear Wheels	202
Admiralty.....	202
Commercial	184
Turnings	179
Lead	
Scrap	57
Nickel	
Cuttings	—
Anodes	540
Phosphor Bronze	
Scrap	184
Turnings	179
Zinc	
Remelted	79
Cuttings	66
Old Zinc	46

Metal Statistics

Detailed figures of the consumption and output of non-ferrous metals for the month of January, 1961 have been issued by the British Bureau of Non-Ferrous Metal Statistics, as follows in long tons:—

COPPER	Gross Weight	Copper Content
Wire	23,086	22,633
Rods, bars and sections	15,843	10,303
Sheet, strip and plate	14,145	11,117
Tubes	8,171	7,564
Castings and miscellaneous	8,305	—
Sulphate	3,055	—
	72,605	59,155
Of which:		
Consumption of Virgin Copper		45,187
Consumption of Copper and Alloy Scrap (Copper Content)		13,968

LEAD	
Cables	7,981
Batteries	2,762
Battery Oxides	3,013
Tetra Ethyl Lead	2,292
Other Oxides and Compounds	1,900
White Lead	717
Shot	493
Sheet and Pipe	5,722
Foil and Collapsible Tubes	402
Other Rolled and Extruded	746
Solder	1,488
Alloys	1,865
Miscellaneous Uses	1,764
Total	31,145

TIN	
Tinplate	743
Tinning:	
Copper Wire	39
Steel Wire	8
All other	71
Solder	163
Alloys	564
Foil and Collapsible Tubes, etc.	50
Tin Compounds, Salts, and Miscellaneous Uses	165
Total Consumption	1,803

ZINC	
Galvanising	7,974
Brass	10,422
Rolled Zinc	2,024
Zinc Oxide	1,855
Zinc Die-casting alloy	4,286
Zinc Dust	1,217
Miscellaneous Uses	959
Total, All Trades	28,737
Of which:	
High purity 99·99 per cent	4,853
Electrolytic and high grade 99·95 per cent	4,874
Prime Western, G.O.B. and debased	11,235
Remelted	537
Scrap Brass and other Cu alloys	4,412
Scrap Zinc, alloys and residues	2,491

ANTIMONY	
Batteries	133
Other Antimonial Lead	47
Bearings	25
Oxides—for White Pigments	142
Oxides—other	151
Miscellaneous Uses	16
Sulphides	7
Total Consumption	521
Antimony in scrap	
For Antimonial Lead	504
For Other Uses	74
Total Consumption	578

CADMIUM	
Plating Anodes	51·45
Plating Salts	15·10
Alloys: Cadmium Copper	9·95
Alloys: Other	3·05
Batteries: Alkaline	9·30
Batteries: Dry	0·35
Solder	7·95
Colours	21·15
Miscellaneous Uses	2·60
Total Consumption	120·90

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

France (new francs per kilo):

Electrolytic copper scrap	(£218.0.0)	2.95
Heavy copper	(£218.0.0)	2.95
No. 1 copper wire	(£203.4.0)	2.75
Brass rod ends	(£164.1.0)	2.22
Zinc castings	(£67.19.0)	0.92
Lead	(£65.0.0)	0.88
Aluminium	(£134.9.0)	1.82

Italy (lire per kilo):

Aluminium soft sheet clippings (new)	(£178.2.0)	305
Lead, soft, first quality	(£80.0.0)	137
Lead, battery plates	(£44.19.0)	77
Copper, first grade	(£214.2.0)	365
Bronze, commercial gunmetal	(£178.2.0)	305
Brass, heavy	(£148.18.0)	255
Brass, light	(£134.6.0)	230
Brass, bar turnings	(£148.18.0)	255
Old zinc	(£64.4.0)	110

Japan (Yen per metric ton):

Electrolytic copper	(£—)	283,000
Copper wire No. 1	(£—)	265,000
Copper wire No. 2	(£—)	250,000
Heavy copper	(£—)	250,000
Light copper	(£—)	215,000
Brass, new cuttings	(£—)	200,000
Red brass scrap	(£—)	212,000

West Germany (D-marks per 100 kilos):

Used copper wire	(£204.19.0)	225
Heavy copper	(£204.19.0)	225
Light copper	(£182.4.0)	200
Heavy brass	(£132.1.0)	145
Light brass	(£95.13.0)	105
Soft lead scrap	(£52.16.0)	58
Zinc scrap	(£52.16.0)	58
Used aluminium unsorted	(£81.19.0)	90

Financial News

An Acquisition

Purchase of all the physical assets of the Consolidated Smelting and Refining Company of Detroit, Michigan, by the Electric Autolite Company was announced last week by the Autolite President, Mr. Robert H. Davies. The modern five-year-old facility will continue to operate primarily as a lead smelter, Mr. Davies said.

Delta Metal Company

Group profit for the year is shown at £3,776,968 (before tax), as against £2,879,879 for 1959. A final dividend of 7½ per cent plus a bonus of 7½ per cent is recommended, bringing the total for the year to 20 per cent.

Trade Publications

Instrumentation in Industry. — Department of Scientific and Industrial Research, 5-11 Regent Street, London, S.W.1.

Despite the increasing use of instruments in modern manufacturing processes there is still scope for improving instrumentation in most industries. The advantages are considerable and these—together with the problems, especially for the smaller firm—are discussed in plain language in a D.S.I.R. booklet entitled "Instruments in the Factory". This booklet describes how quite simple instruments can save money and increase efficiency. It is issued free of charge.

Electroplating Plant—W. Canning and Company Ltd., Great Hampton Street, Birmingham, 18.

This latest publication of 40 pages deals with automatic plating plant and describes the different types of Canning automatic equipment, as well as illustrating installations by manufacturers and trade platers covering a wide range of applications. They show how a wide variety of requirements has been met by the use of automatic equipment.

Conveyor Roller Chains. — Precision Chains Ltd., Clayton Lane, Manchester, 11.

A three-fold leaflet is devoted to this company's range of steel conveyor chains. Statistics and diagrams are given, as well as other useful information.

Superconductivity. — General Electric Research Laboratory, P.O. Box 1088, Schenectady, N.Y., U.S.A.

The winter bulletin of the Research Laboratory contains a special section dealing with superconductivity, together with charts, diagrams and photographs. A major discovery that may yield vastly improved knowledge of both superconductivity and electron "tunnelling" was revealed late in 1960 when it was announced that tunnelling had been observed for the first time in devices consisting simply of two metal films separated by a thin insulating layer, with one or both of the metal films in the superconducting state. It is suggested that this discovery may presage a new family of electronic devices.

THE STOCK EXCHANGE

Industrial Share Market Generally Strong In Tone

ISSUED CAPITAL *	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 20 MARCH +RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1961 HIGH	1961 LOW	1960 HIGH	1960 LOW
£	£			Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	32/6	11	9	6 15 6	32/6	26/3	35/–	26/6
400,000	2/–	Anti-Attrition Metal	1/–	NIL	4	NIL	1/–	0/9	1/6	0/9
43,133,593	Stk. (£1)	Associated Electrical Industries ...	46/6xd —6d.	15	15	6 9 0	48/6	40/3	67/3	38/3
3,895,963	1	Birfield	53/– +2/9	10	15‡	3 15 6	53/–	45/–	51/3	29/–
4,795,000	1	Birmid Industries	85/6 +1/3	20	20D	4 13 6	85/6	71/3	74/9	56/–
8,445,516	Stk. (10/–)	Birmingham Small Arms	34/6 +1/9	17½QT	12½	3 13 3	34/6	24/9	30/6	18/3
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	14/6	5	5	6 18 0	14/4½	14/–	17/4½	14/9
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/6 —3d.	6	6	7 5 6	17/6	16/9	20/–	17/1½
500,000	1	Bolton (Thos.) & Sons	48/9	12½	10	4 6 6	48/9	37/6	43/–	36/–
300,000	1	Ditto Pref. 5%	14/3 +3d.	5	5	7 0 3	14/3	13/9	16/–	14/3
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	17/–	6	6	7 1 3	18/–	16/6	21/1½	17/7½
18,846,647	Stk. (£1)	British Insulated Callender's Cables	57/9 +6d.	13½	13½	4 13 6	58/–	50/4½	61/4½	47/–
20,456,599	5/–	British Oxygen Co. Ltd., Ord. ...	31/3 +1/3	16	16	2 11 0	31/3	26/3	35/–	19/10½
1,200,000	Stk. (5/–)	Canning (W.) & Co.	18/6 +1/6	15 + 8½C	25 + *2½C‡	4 1 0	20/–	13/7½	19/9	13/7½
60,484	1/–	Carr (Chas.)	1/4½	NIL	12½	—	1/6	1/–	2/3	1/–
555,000	1	Clifford (Chas.) Ltd.	29/– +1/–	12	10	8 5 6	29/–	26/–	35/–	28/9
45,000	1	Ditto Cum. Pref. 6%	15/3	6	6	7 17 6	15/3	15/1½	16/–	15/10½
300,000	2/–	Coley Metals	3/9 —3d.	15	15	8 0 0	4/2½	3/6	5/–	3/4½
10,185,696	1	Cons. Zinc Corp.†	69/6	20	15	5 15 0	70/6	64/–	80/9	59/6
5,399,056	1	Davy-Ashmore	175/– +9/6	30‡	20	1 14 3	175/–	129/6	147/3	99/6
8,000,000	5/–	Delta Metal	24/– +6d.	20	17½	4 3 3	24/–	19/9	28/3	18/6
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	52/3 +3/9	15	15	5 14 9	52/3	45/–	56/9	45/–
1,155,000	1	Evered & Co.	45/– +1/–	10‡	10φ	2 19 6	45/–	42/6	42/9	29/3
18,000,000	Stk. (£1)	General Electric Co.	36/– —2/6	10	10	5 11 0	39/6	29/6	47/9	29/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	59/9 +2/–	25	20	4 3 9	59/9	42/9	52/6	40/–
1,037,492	5/–	Glacier Metal Co. Ltd.	16/3 +3d.	13	11½	3 19 0	16/6	13/9	16/1½	11/1½
2,500,000	5/–	Glynwed Tubes	25/9 +1/6	25¶	20	3 4 0	25/9	23/7½	27/6	17/–
7 228,065	10/–	Goodlass Wall & Lead Industries ...	39/3 —1/–	19L	16	3 12 6	41/9	34/9	41/9	33/–
696,780	10/–	Greenwood & Batley	25/3xcap +3d.	30W	30	5 18 9	27/–	23/9Z	33/6	29/1½
792,000	5/–	Harrison (B'ham) Ord.	13/6	*20‡	*17½	3 14 0	13/6½	12/3	15/10½	11/9
150,000	1	Ditto Cum. Pref. 7%	20/–	7	7	7 0 0	20/3	20/–	23/6	22/–
1,612,750	5/–	Heenan Group	15/–xd —3d.	13	15	4 6 9	15/6	10/6	13/–	9/10½
251,689,407	Stk. (£1)	Imperial Chemical Industries ...	71/3 +9d.	11½N	8	3 3 3	71/10½	63/1½	76/6	54/–
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	15/6	5	5	6 9 0	15/9	15/3	18/–	15/4½
29,184,044	**	International Nickel	123½ +1½	$1.60	$1.50	2 7 0	123	104	105	84½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	14/3	5	5	7 0 3	14/10½	14/–	16/6	14/6
6,000,000	1	Ditto Ord.	61/3	12	12D	3 18 6	62/9	59/6	67/6	44/9
600,000	10/–	Keith, Blackman	21/– +3d.	17½	17½E	8 6 9	21/–	18/3	32/6	17/6
320,000	4/–	London Aluminium	10/9 +4½d.	12	10	4 9 3	10/9	8/6	12/6	7/10½
765,012	1	McKechnie Bros. Ord.	54/– +3d.	17½F	15F	6 9 6	56/9	53/6	71/6	57/3
1,530,024	1	Ditto A. Ord	53/3	17½F	15F	6 11 6	55/–	53/3	69/3	55/–
1,108,268	5/–	Manganese Bronze & Brass	18/3 +2/–	20⅝	20⅝	5 13 0	18/6	14/–	18/6	13/4½
50,628	6/–	Ditto (7½% N.C. Pref.)	5/6 —3d.	7½	7½	8 3 9	6/–	5/6	6/6	5/9
26,361,444	Stk. (£1)	Metal Box	87/6 +2/6	12M	13B	2 9 6	87/6	68/3	84/3	61/–
415,760	Stk. (2/–)	Metal Traders	8/–	50	50	12 10 0	8/–	6/9	10/9	7/1½
160,000	1	Mint (The) Birmingham	37/– +3d.	10	10	5 8 0	37/–	36/–	39/–	33/6
80,000	5	Ditto Pref. 6%	76/3	6	6	7 17 6	77/6	76/–	80/–	75/–
5,187,938	Stk. (£1)	Morgan Crucible A.	62/– +1/6	13	12	4 4 0	62/–	53/4½	63/–	47/6
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	15/6 —6d.	5½	5½	7 2 0	17/–	15/3	18/9	15/9
3,850,000	Stk. (£1)	Murex	44/– +6d.	22½J	15	5 16 6	44/–	39/9	45/–	35/3
585,000	5/–	Ratcliffs (Great Bridge) Ord. ...	16/–	10	10R	3 2 6	16/6	16/–	17/–	14/9
195,000	5/–	Ditto 8% Max. Ord.	5/–	8	—	8 0 0	5/–	4/10½	5/3	5/–
1,064,880	10/–	Sanderson Kayser	38/–	35‡	25	4 12 3	38/–	33/9	40/3	27/7½
3,400,500	Stk. (5/–)	Sarck	17/6 +3d.	12½	17½GD	3 11 6	18/3	15/–	25/6	15/3
8,035,372	Stk. (£1)	Stone-Platt Industries	66/6 +6d.	15	15	4 10 3	66/6	55/–	64/4½	52/3
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	15/9 +9d.	5½	5½	6 19 9	15/9	15/–	18/7½	15/3
35,344,881	Stk. (£1)	Tube Investments Ord.	84/6 +4/9	14	20	3 6 3	84/6	72/3	140/3	63/10½
41,000,060	Stk. (£1)	Vickers	33/3 +1/9	10	10	6 0 6	33/3	28/–	39/7½	27/1½
750,000	Stk. (£1)	Ditto Pref. 5%	13/6 +6d.	5	5	7 8 3	13/6	12/7½	17/6	13/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	20/3 —3d.	*5	*5	7 7 0A	20/7½	19/9	24/6	20/1½
4,594,418	1	Ward (Thos. W.) Ord.	75/6 +9d.	13¾	25	3 12 9	76/–	64/6	94/–	63/–
7,109,424	Stk. (£1)	Westinghouse Brake	40/3 —3d.	11	10	5 9 3	41/7½	36/4½	60/6	37/6
315,895	2/–	Wolverhampton Die-Casting ...	10/– +1½d.	35	30	7 0 0	10/–	9/–	13/10½	8/1½
591,000	5/–	Wolverhampton Metal	28/9 —6d.	32½	27½	5 12 3	29/3	24/6	39/9	23/9
156,930	2/6	Wright, Bindley & Gell	4/– —1½d.	15	20‡	9 7 6	4/3	3/7½	4/3	2/10½
124,140	1	Ditto Cum. Pref. 6%	13/6	6	6	8 17 9	13/7½	13/6	15/–	13/6
150,000	1/–	Zinc Alloy Rust Proof	4/9 —3d.	40	30	8 8 6	5/3	4/6	5/4½	4/–

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% capitalized issue. ⊕The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. D and 50% capitalized issue. C paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. R and 33⅓% capitalized issue in 8% Maximum Ordinary 5/– Stock Units. φ and 6½% from Capital Profits B and 50% capitalized issue. G and 1½d. special distribution. F and special 5% tax free dividend. H As forecast. ¶And 3 for 7 capitalized issue. L and 33⅓% capitalized issue. M and 10% capitalized issue. N Interim since increased. J and 75%capitalized issue. S and 40% capitalized issue. O calculated at 13⅓%. Interim on smaller capital. P Calculated at 11½%. Q also 1/– special tax free dividend and 50% capitalized issue. T Per £1 unit. W Before capital reorganization. Calculated at 15%. Z After capital reorganization

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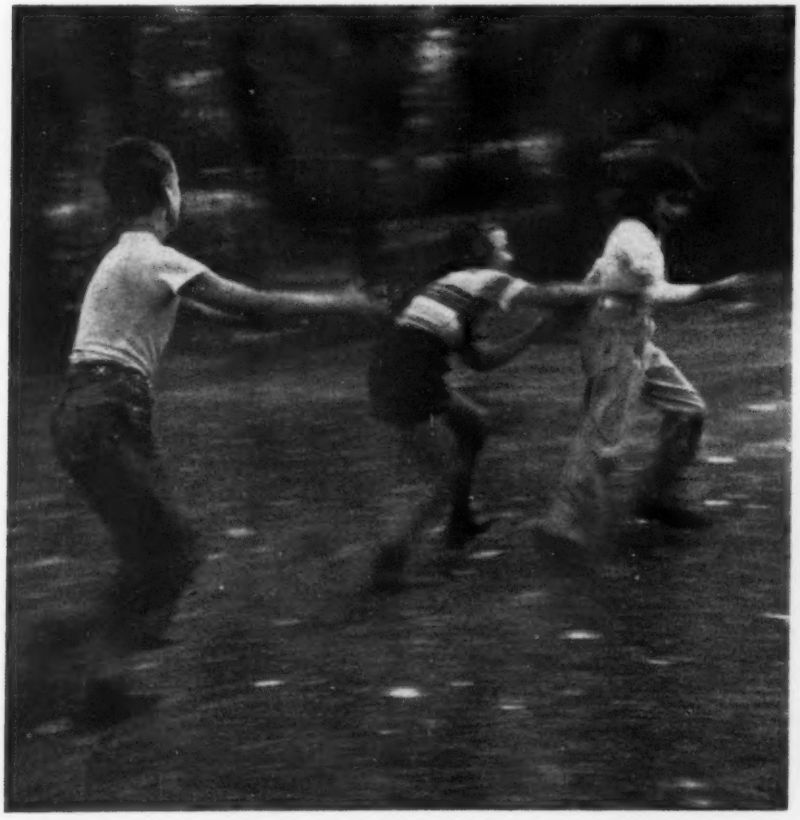

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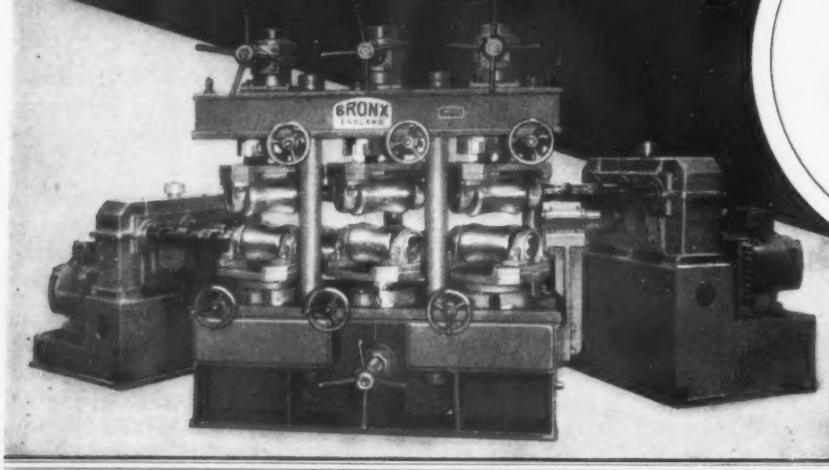

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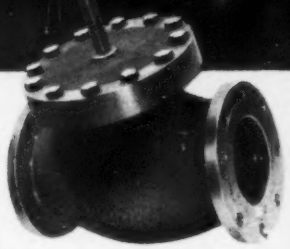

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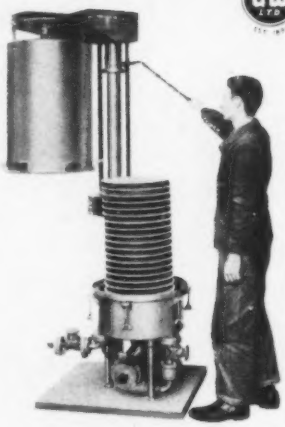

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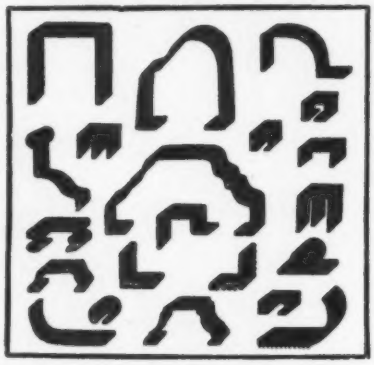

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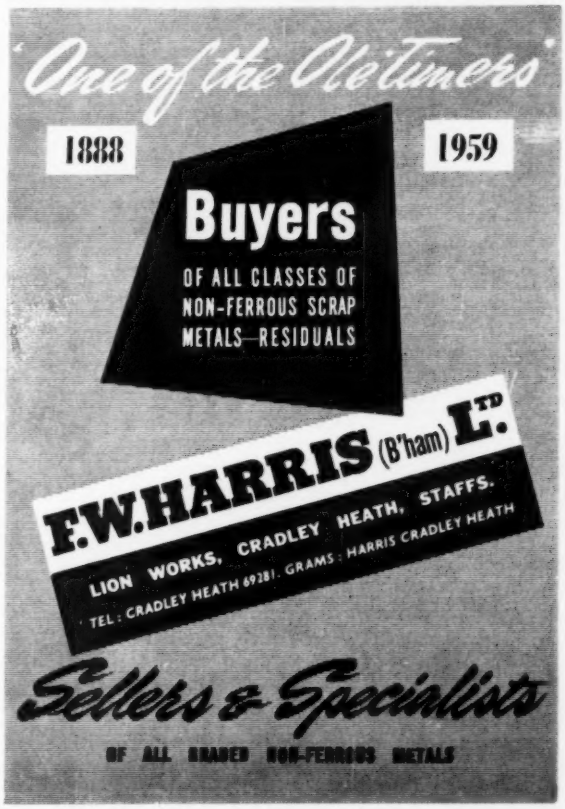

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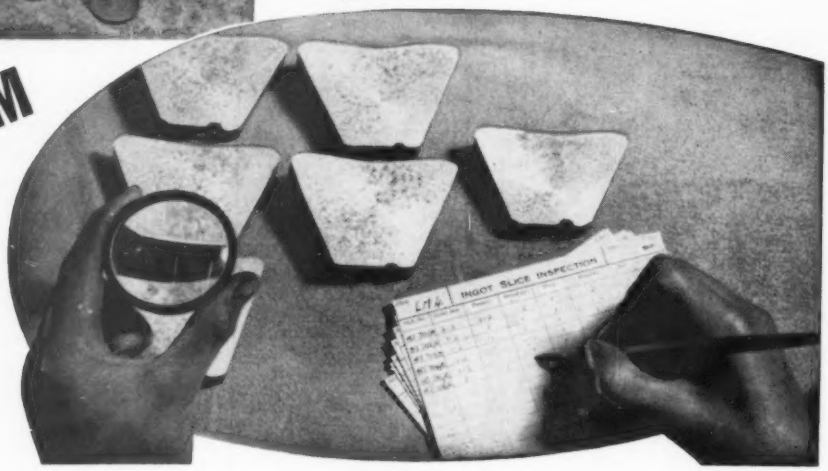

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